Storage Solutions - Projects and Ideas Inside

MARCH 2004 ISSUE 154

Better Homes and Gardens®

WOOD®

The Shop-Proven Woodworking Magazine

bookcases made easy

Build any of 3 classic styles p.56

SUPER-SIMPLE CHAIR MAKING

p.80

TONERS: THE SECRET TO PERFECT STAINING

p.66

10 GREAT projects for home and shop

TESTED & RATED

- Sliding Mitersaws p.74
- Laser Levels p.14
- Rust Removers p.87

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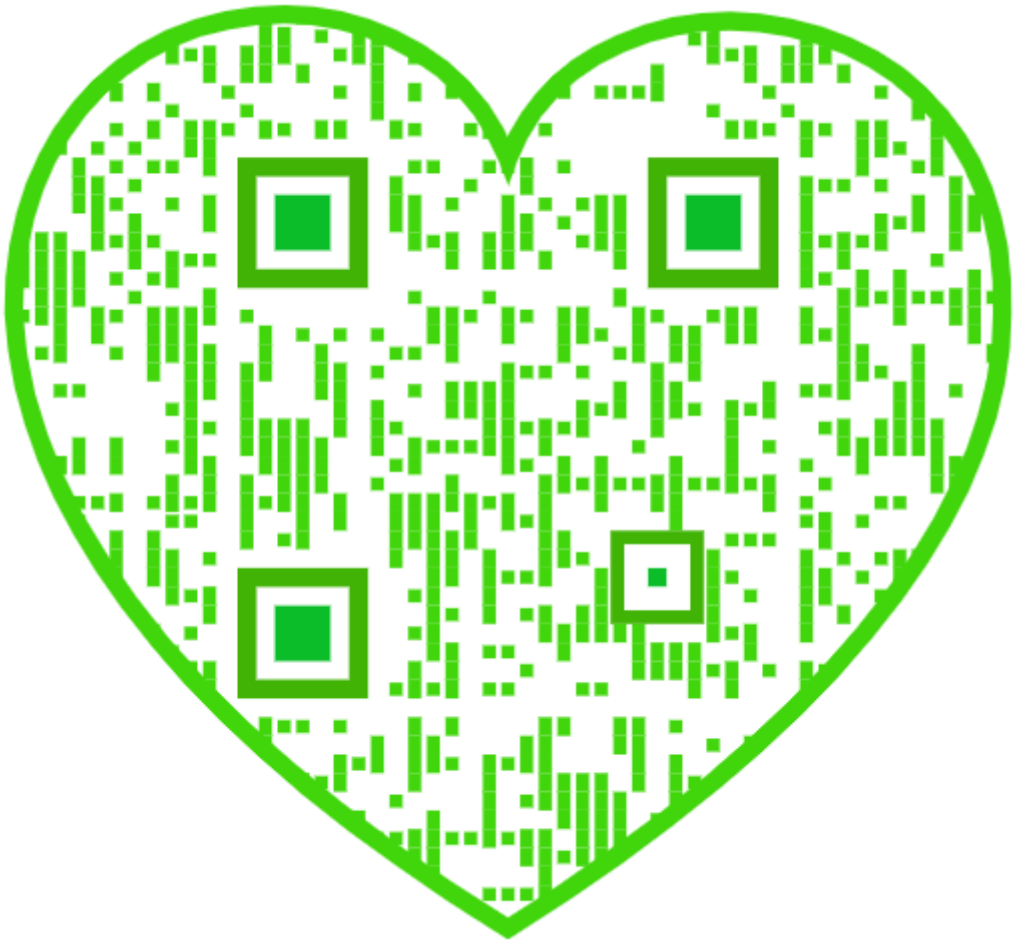

WOOD®

March 2004, Issue 154

PROJECTS

12 **dowel chamfering jig**

20 **workshop drawer organizer**

56 **one bookcase, three classic styles**

64 **shelf-top weather station**

70 **turned trivets**

80 **traditional oak dining chair**
Learn mortise-and-tenon joinery while making chairs that match the dining table in issue 152.

90 **stackable CD boxes**
Teach a youth woodworking with a project that suits his or her interest and skill level.

96 **cat's meow scrollsawn plaque**
Cut out a pride of kitties and frame them, all from just one piece of wood.

TECHNIQUES

50 **the shelf-maker's complete guide**
Discover the secrets, materials, and hardware you need for good-looking, no-bow shelving.

66 **wood toning 101**
Tweak wood stains, blend mismatched boards, and shade projects with these finishing tricks.

84 **seat cushions made easy**
Make comfy upholstered seats in just six steps.

TOOLS & MATERIALS

14 **wise buys: low-cost laser levels**

74 **review: 10" sliding mitersaws**

87 **rust busters**
Find out what products best remove rust from cast-iron surfaces and keep it from returning.

110 **7 shop-proven products**

FEATURES

24 **chair design standards**

42 **how to find pearls in burls**

46 **a toy maker's secrets for moving parts**
For an education on articulation, check out craftsman Mike Jagielo's winning designs.

104 **one puzzling woodworker**
Learn precision from a master puzzle maker.

DEPARTMENTS

6 **editor's angle**

8 **masthead**

10 **sounding board**

26 **shop tips**

34 **ask *WOOD***

100 **short cuts**

124 **what's ahead**

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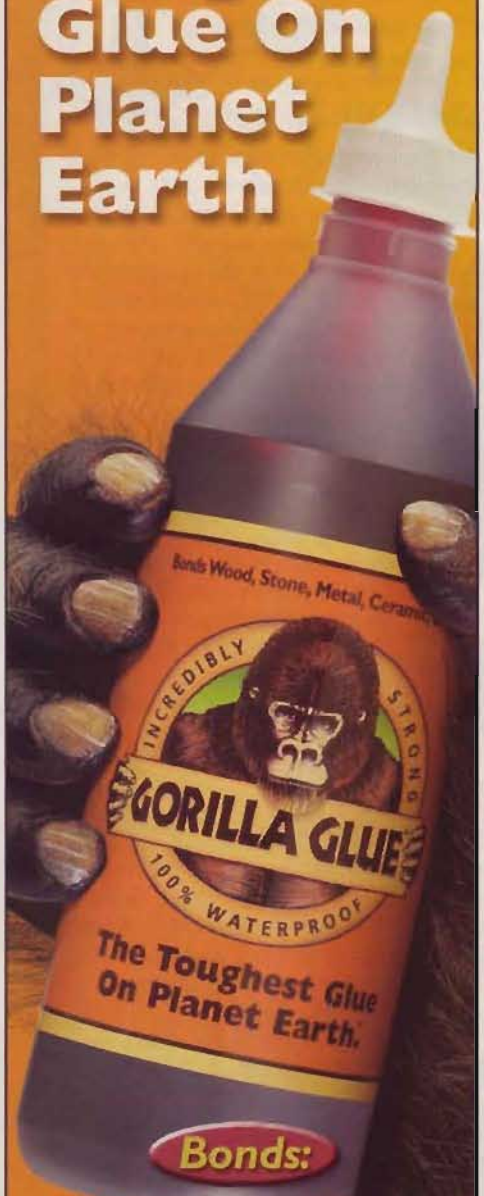

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editor's angle

A "Way-cool" way to enjoy your shop time

If you read this column regularly, you know that I believe we all should pass along our woodworking skills to the next generation. That's one reason you'll find a first-of-its-kind "Way-cool" woodworking project in this issue. We designed, wrote, and produced this project—a modular CD storage system—so you and a child can build it working side by side.

These CD racks designed by my daughter Rachel (left) and her friend Abby Williams served as the inspiration for the CD storage system in this issue.

A few months ago, my 13-year-old daughter Rachel and her friend Abby came to me with a stack of 2×4 scraps and a rough plan for turning them into CD holders. Initially, the woodworker in me recoiled at the thought of building anything but house framing from 2×4s. Then I reasoned that the girls would take a lot more pride in the project if we stayed true to their original vision. So we built those CD racks from 2×4s, just as they drew them up. (See photo.)

Now, I must tell you that this was the first time that Rachel had ever approached me about making a woodworking project. And as I pondered that, a simple fact suddenly dawned on me: Kids are much more interested in woodworking when they build something they actually want. (As opposed to the wall shelf, dust pan, end table, and pop-can lamp that I was forced to build in high school shop classes.)

And that's how the idea for "Way-cool" woodworking projects was hatched. Our goal with this new series is to bring you simply designed projects that kids really want to build, and to facilitate the process of you and a child working together in a safe and enjoyable way.

To do that, Senior Design Editor Kevin Boyle kept the CD storage system on *page 90* basic enough for a child to build successfully with a little help. He also made it sufficiently stylish so that you'll want to build one (or more) even if you don't have a young apprentice.

Projects Editor Owen Duvall then teamed with his 8-year-old son, David, to produce the "Way-cool" article in a unique fashion. The story is in two sections: In the first one, you cut the parts to size as your apprentice observes; in the next section, you and the child share marking, machining, assembling, and finishing tasks.

We're bigger, and you're the winner. You may have noticed (starting with issue 153) that our pages are ⅜" wider and ⅜" taller. That may not seem like a lot, but it takes every page from 84 square inches to 91 square inches! That's an increase of more than 8 percent in the amount of editorial material we can pack onto every page. I'm thrilled that we can bring you this extra content.

Bill Krier

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Kevin recently completed this walnut desk for his home.

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In Memoriam — E.T. Meredith III (1933-2003)

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sounding board

Our bulletin board for letters, comments, and timely updates

Reader devises a different way to slice a thin-strip ripping jig

I read with great interest your article on "3 must-have tablesaw jigs" (issue 151, page 80), and especially liked the thin-strip ripping jig. The article noted that cutting thin strips against the fence can be dangerous because it becomes difficult to use a pushstick or blade guard.

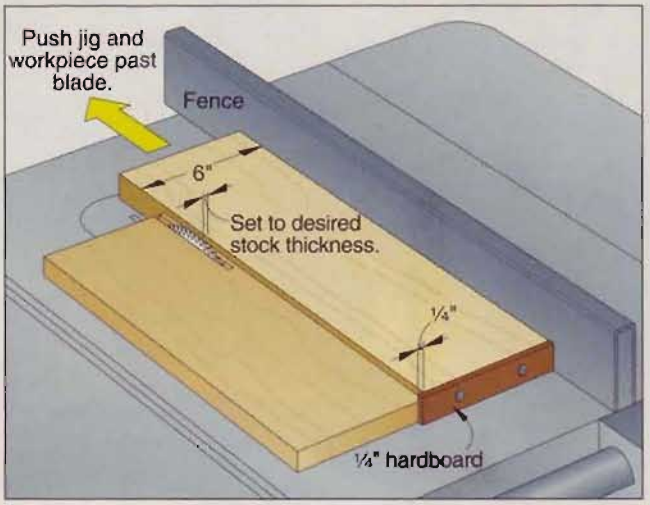
Your jig works great, and is ideal for cutting long strips. I designed a jig, shown at *right*, that lets me rip short strips (less than 2' long), without having to readjust the fence between cuts or get my hands close to the blade.

To make it, I cut a piece of ¾" scrap to 6×24". Then I attached a ¼" hardboard cleat to one end (using just screws, no glue) so that it overhangs one edge by ¼".

To use the jig, position the rip fence to leave a gap between the blade and jig equal to the desired thickness of the strip. Then place the workpiece against the jig, as shown, and push the jig and workpiece past the blade.

You can use the jig to rip thinner strips, too. Doing this will cut away the end of the cleat but that's not a problem. If this happens, just remove the old cleat and screw a new one in place.

Cliff Reid, Greenville, Ind.



Delta updates Unisaw blade guard

Your recent review of cabinet-style tablesaws (issue 151, page 74), mentioned as a "low point" that the blade guard on the Delta 36-L31X-U50 could not be "parked" in the up position with the throat plate in place.

We understand that being able to temporarily move the guard out of the way greatly simplifies measuring and set up. So, in an effort to make those tasks easier, we changed the assembly so that the guard will stay up when the throat plate is in place.

Safety is of the utmost importance for everyone in the woodworking industry, and we endorse the use of the guards and splitters to help prevent accidental contact with the blade and to help prevent kick-back. If the guard has been "parked" in the up position, the user should lower it into position prior to cutting. However, if the user does not do this prior to cutting, the guard will automatically drop into position when the wood contacts it, providing a safety barrier between him and the blade.

Kendall Smith, Director of Product Management and Biesemeyer Marketing, Delta Machinery

Tool test update

Pocket-hole jigs (issue 152, page 62): The Kreg ProPack includes the Mini, Rocket, and K2000 jigs. Hole spacing on the K2 model is ⅞". Spacing on the K2000 is 9/16, ⅞, and 1 7/16". ♣

HOW TO REACH US

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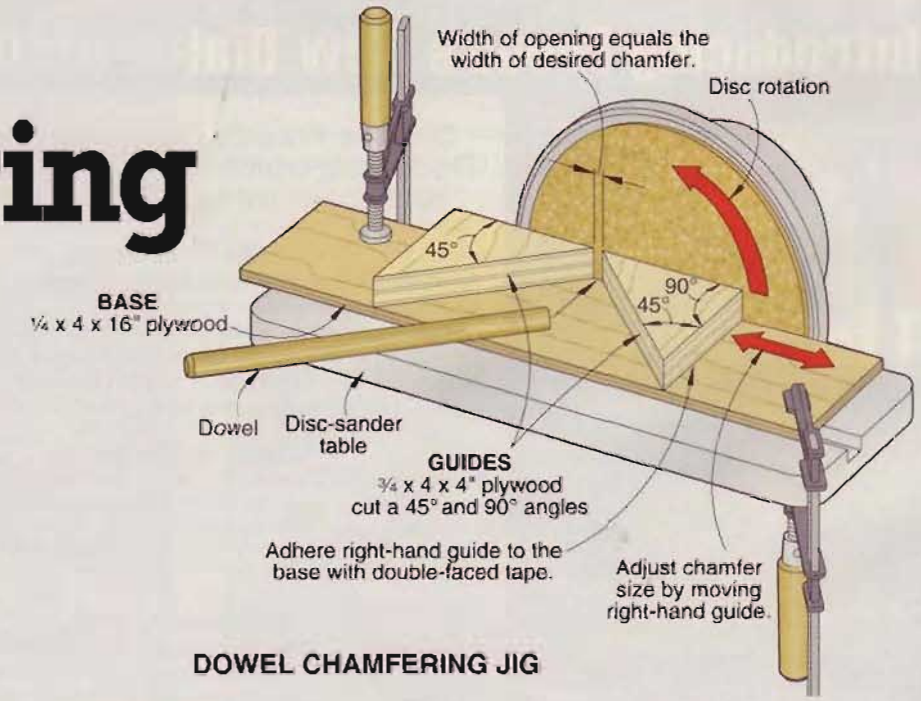
- **Updates to previously published projects:** For a complete listing of known changes in dimensions and buying-guide sources from issue 1 through today, go to woodmagazine.com/editorial.

dowel chamfering jig

Create precise chamfers with this nifty disc-sander accessory jig.


Width of opening equals the width of desired chamfer.
Disc rotation
45°
90°
45°
BASE
¼ x 4 x 16" plywood
Dowel
Disc-sander table
GUIDES
¾ x 4 x 4" plywood cut a 45° and 90° angles
Adhere right-hand guide to the base with double-faced tape.
Adjust chamfer size by moving right-hand guide.

DOWEL CHAMFERING JIG

Chamfered dowels insert easier for alignment purposes, like those used in our CD rack on *page* 92 and chamfered ends also create glue space for stronger dowel joints.

To quickly create your own consistently chamfered dowels, build the jig shown. We used ¼" plywood for the base and ¾" plywood for the two 45° guides. The key is that the right-hand guide is moveable to widen or narrow the gap between the guides, allowing you to increase or decrease the size of the sanded chamfer. We screwed the left-hand guide in place, and secured the right-hand guide with double-faced tape. To use the jig, simply clamp it to your disc-sander table so the inside edge of the jig is next to but not touching the sanding disc. Start the sander, slide the dowel along the left-hand guide, and rotate the end of the dowel clockwise against the disc. The right-hand guide acts as a stop to prevent you from sanding too large a chamfer. If the chamfered end isn't sanding enough, simply move the right-hand guide away from the other guide.

Project Design: **Kevin Boyle**

our editors test

low-cost laser levels

Why buy?

If you are doing a task that requires a long level or plumb line, these tools greatly simplify it. Common applications include installing wallpaper or paneling; attaching cabinets or countertops; or hanging shelves, pictures, or drop ceilings. When in use, these tools emit a laser beam that's level, plumb, or at odd angle, depending upon how you set the device. Most of the devices are recommended for indoor use only, as the line they project can be difficult to read in bright sunlight.

Craftsman Laser Trac, $40

Editor test-drive:

The instruction manual is clear about how to use this simple laser level. First, I mounted it to an ordinary camera tripod using the supplied "precision manual leveling base." (The laser mounts to its base using magnetic plates, and casts a 100°-wide line.) Three thumb screws on the base make it a snap to level the 2-axis bubble levels. Then, from a distance of 20', I checked the LaserTrac for accuracy using a high-quality 4' level. It was right on the money. I rotated the laser for a plumb line, and again, it was right on.

Because Craftsman specs its accuracy at plus or minus ½" at 30', I wouldn't use it to build something as critical as a building foundation, for example. And it's not recommended for use outdoors. But the tool is great for shorter distances and interior projects and is a great value. Its $40 price includes a push-pin wall-mounting plate and a padded case.

—Tested by Bill Krier, Editor-in-Chief

To learn more:

Visit a Sears store, www.sears.com/craftsman

Strait-Line Laser Level, $40

Editor test-drive:

This surface-mount-only unit sets up easily—you just level it with two integrated bubble vials, and it casts a line the manufacturer says is accurate to plus or minus ½" at 20'. To attach the level to a vertical surface, I used an optional no-mar leveling base to stick the unit to painted drywall and accurately placed a series of three photos at a uniform height. The Strait-Line's no-mar base worked perfectly, and avoided the tell-tale pinholes that the standard push-pin base would have left there.

The laser line is consistent and easy to see, and, though it leaves a slight gap in the laser line, it can "see" around minor obstructions, such as moldings. An optional stud finder attachment proved ideal for marking stud locations when hanging wallboard or shelving. (There's no provision for a tripod mount, however.) I also used it to install a vinyl tile floor without a messy chalk line by simply lining up the two notches on the ends of the level with the center line on my floor.

—Tested by Kevin Boyle, Senior Design Editor

To learn more:

800/464-7946, www.strait-line.com

Black & Decker Crosshair, $50

Editor test-drive:

The Crosshair projects two laser lines—one horizontal, one vertical—at the same time. Because the laser "floats" in its case (so long as I held or hung it within 5° of level), the unit automatically found level within a couple of seconds. Hanging shelves in my family room, I used the device's single-pin hanger to pierce the drywall in the room at shelf height. (I verified the accuracy of the line with a 4' level; it was dead on.) For layout purposes—say, when installing a stair railing—the floating head locks into a fixed position.

About 10' out from the Crosshair, the laser line becomes faint to the eye, but a handy gadget that comes with the level picks up that faint line so you can transfer it accurately to your work surface. I have only one gripe about the Crosshair: Because it generates a line only to the right of the level, you can't shoot a line to the left. So, you can't work both directions from a mark in the corner, for example, because the self-leveling feature doesn't work with the instrument upside down (which it would have to be to generate a line to the left).

—Tested by Dave Campbell, Products Editor

To learn more:

800/544-6986, www.blackanddecker.com

workshop drawer organizer

Keep small tools and accessories in this convenient lift-out box.

WOOD MAGAZINE'S IDEA SHOP 5

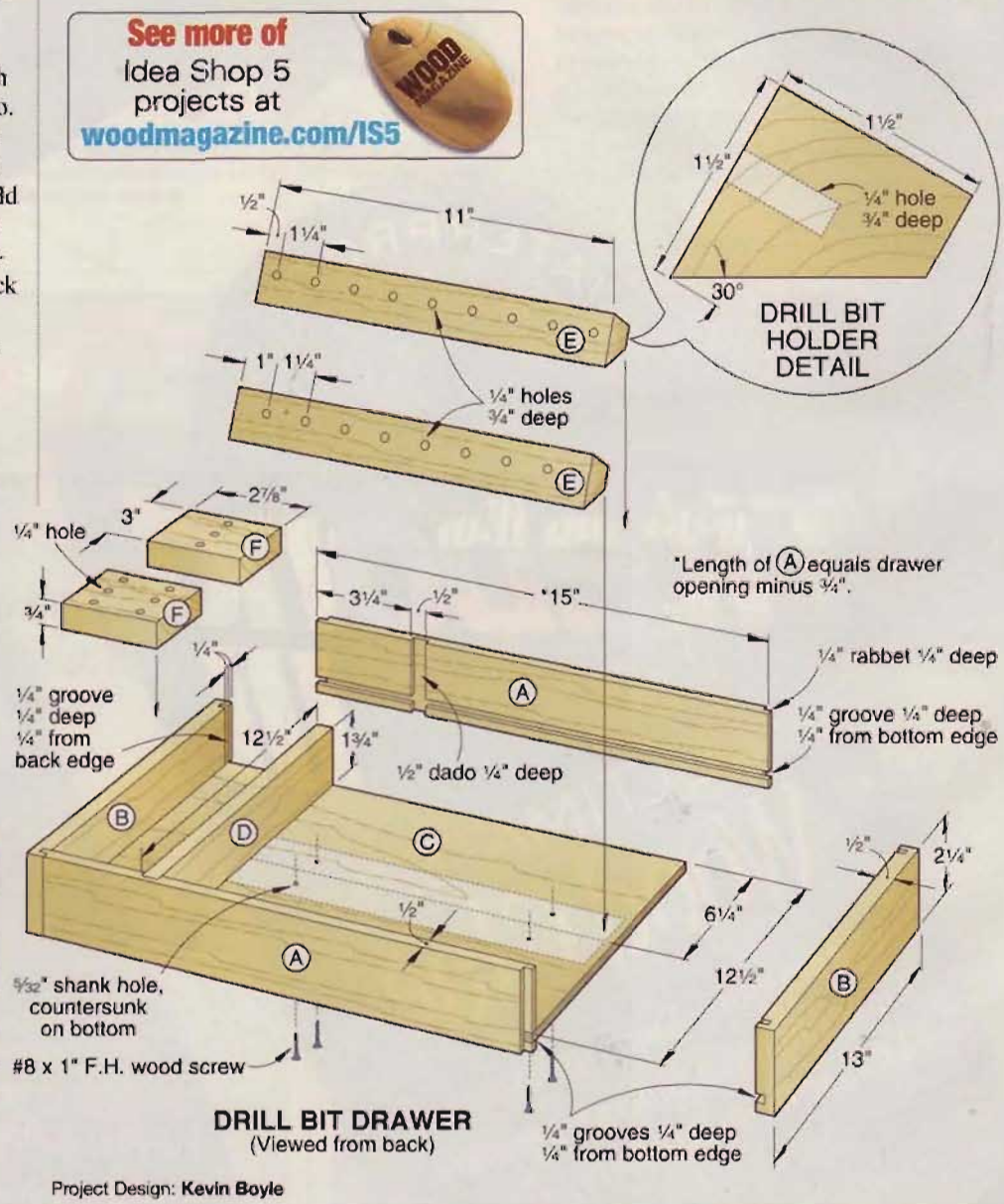
No matter the size of your shop drawers, this compartmentalized box keeps everything tidy. If need be, you can remove the box quickly to wherever you're working.

To build an organizer, measure the width of the drawer you want the insert to fit into. We dimensioned ours to fit into the utility cabinet drawer shown on page 74 of issue 152. The overall width of the drawer should be ¼" less than the measured opening. To accomplish this, measure the drawer opening (side-to-side), and cut the front and back (A) to this size minus ¾".

Cut the sides (B) and bottom (C) to size. Cut the grooves, dadoes, and rabbets in parts A and B, where dimensioned.

Clamp the pieces together, and cut the divider (D) to fit. Cut the drill bit holders (E) to size, bevel-ripping one edge at 30° where shown, *right*. Drill holes in the holders to fit your bit shanks. Drill mounting holes, and screw the holders (E) in place to the box bottom (C). We did not glue the holders (E, F) in place, should we want to resize or relocate them later. Cut the holders (F) to fit, and drill shank holes in them. Apply a clear finish to the insert, and fit into place.

See more of Idea Shop 5 projects at **woodmagazine.com/IS5**



Materials List

Part	FINISHED SIZE T	W	L	Matl.	Qty.
A front and back	½"	2¼"	*15"	M	2
B sides	½"	2¼"	13"	M	2
C bottom	¼"	12½"	15	P	1
D divider	½"	1¾"	12½"	M	1
E bit holders	1½"	1½"	11"	M	2
F small holders	¾"	3"	2⅞"	M	2

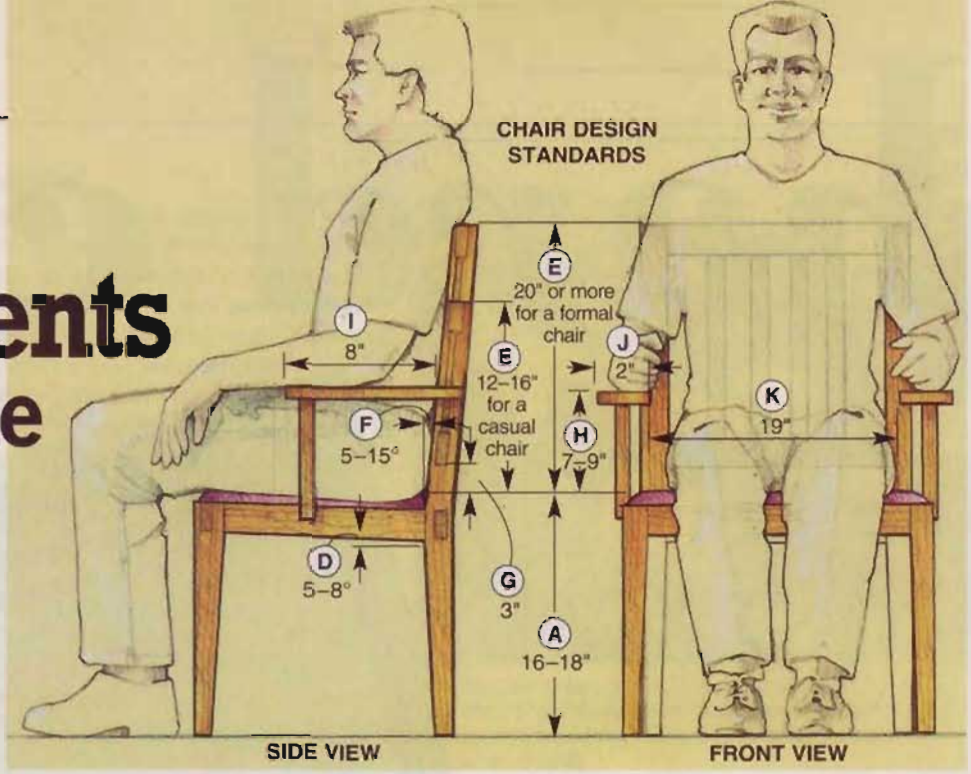
*Length of A equals drawer opening minus ¾".

Materials key: M–maple, P–plywood.

Supplies: #8×1" flathead wood screws.

Project Design: **Kevin Boyle**

must-have measurements for comfortable seating



Thinking about designing a chair but struggling with determining the dimensions and angles that will guarantee maximum comfort? Then let us introduce you to the guidelines established by the furniture industries. Keep in mind that they apply to an average-size 5' 10" adult sitting in an upright position. You may need to adjust the dimensions and angles slightly depending on the intended user's size and shape.

Also, to help with your visual understanding of chair design, we letter-keyed the guidelines for the seat, back, and armrest dimensions and angles to the drawings *above* and *right*. Now, try them out for a chair that looks right and feels great.

First, the seat

(A) For the occupant's feet to rest flat on the floor with a knee angle of 90–100°, locate the seat 16–18" above the floor. If the chair will have a cushion, account for its compressed thickness in the seat height by subtracting half the cushion's thickness.

(B) To allow clearance between the seat's front edge and the occupant's legs, make the seat 15–18" deep.

(C) Aim for a seat width of 16–20". Depending on the chair's style and your preference, you can taper the seat 2–3" from front to back (1–1½" per side). A wider front provides more leg room while a narrower back allows a little more elbow room.

(D) For added comfort, particularly when the chair will not have a cushion, slope the seat 5–8° from front to back. This also helps keep the occupant from sliding forward. For an office or desk chair, though, it's best to forget the slope as a flat seat facilitates leaning forward.

Now, the back

(E) To give lower-back support without interfering with the shoulders, plan for a back height of 12–16" above the seat for a casual chair and 20" (typical) for a formal chair.

(F) Slant the back up to 5° for a formal chair and up to 15° for a casual chair. Keep in mind, though, that as the back angle increases, you need to up the seat angle (to maintain the seat-to-back angle between 90° and 100°) to prevent forward sliding and lower the seat height to keep the front edge of the seat from contacting the back of the legs.

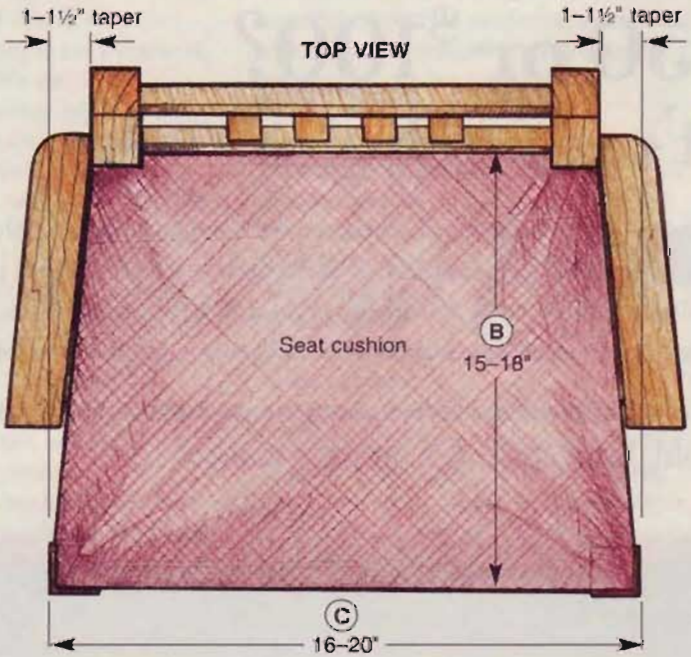
(G) To give "rear" clearance for hind parts, leave 3" of open space between the top of the seat and bottom of the lower backrest, or curve out the lower 4–8" of the backrest.

Finally, the armrests

(H) For the armrests to support the forearms without elevating the shoulders, position them 7–9" above the seat. Be sure to check the table-apron height when determining the armrest height so the arms will slide under the apron.

(I), (J), and (K). Make armrests a minimum of 8" long, 2" wide, and spaced approximately 19" apart.

Illustrations: Mike Mittermeier



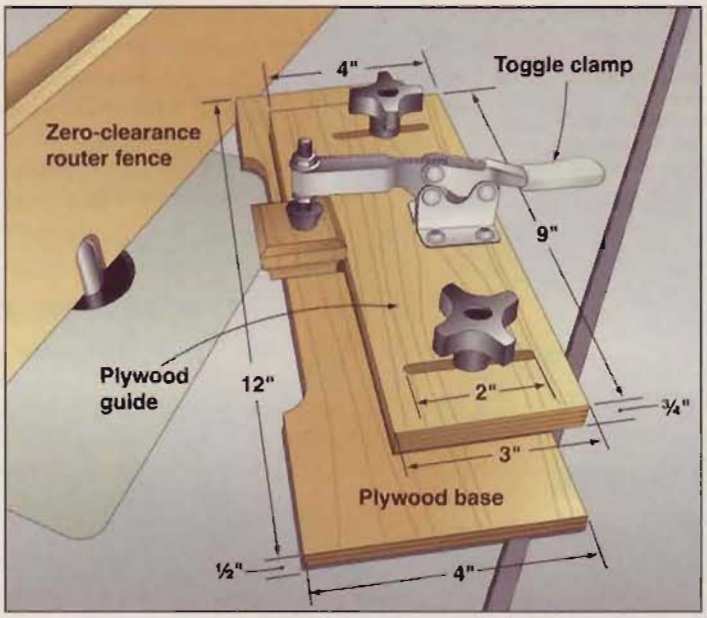
shop tips

Helping you work faster, smarter, and safer

Jig makes it safe to rout small pieces

top shop tip

My table-mounted router seemed ideal for shaping ¾" stock into knobs for a box I was building, but the small blanks—only 1½" square—would make the job hazardous to my hands. So I built the jig, shown at *right*, to hold onto the blanks.



I cut scraps of Baltic birch plywood to the dimensions shown for the jig's base and sliding L-shape guide. To make the jig adjustable, I cut two slots in the guide and attached it to the base with knobs screwed into threaded inserts in the base. A toggle clamp holds the workpiece firmly against the base and the guide. I routed the front edge of the base, as shown, to clear the bit; I then set up the appropriate bit and a zero-clearance fence on the router table to machine the knobs.

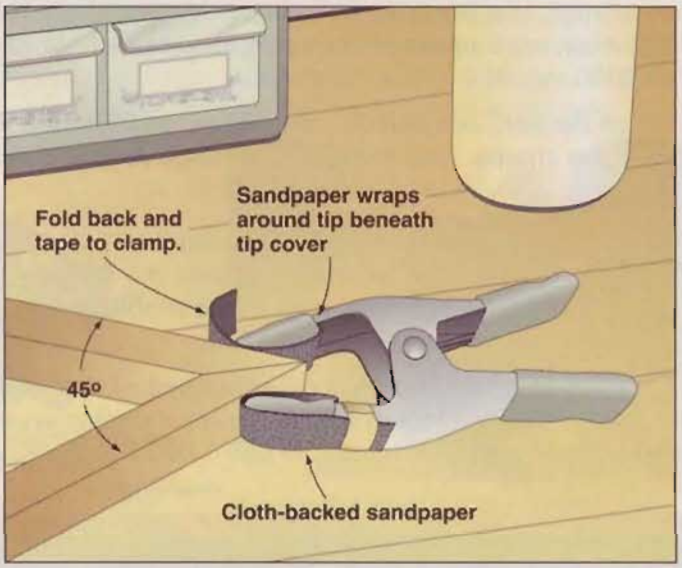
—Bob Lasley, Broken Arrow, Ok.

Here's a cute trick for clamping acute angles

Guessing how far the spring clamp would fly as it popped off the end of an acute-angle glue-up was almost becoming a game in my shop. Then I found that I could get better clamping (although less entertainment) by wrapping a strip of cloth-backed abrasive around the clamp tips.

To keep the strip in place, I slid the resilient tip cover off the clamp and folded one end of a strip of abrasive over the clamp tip, abrasive side facing the clamp. Then I slid the cover back onto the clamp and folded the abrasive strip back around the clamp—rough side out, as shown, and up the other side. I taped the free end to the clamp to keep the strip tight.

—Erv Roberts, Des Moines, Iowa



Continued on page 28

Our Winner

When we called Bob Lasley to tell him that his tip was tops, he was at a woodworking store conducting a cabinetmaking demonstration. He teaches regularly, often on router use. "Woodworking is my passion," Bob said when we talked later. Our Top Shop Tip winner enjoys building furniture and occasionally small projects. "My wife says every project seems to involve a new tool," he chuckled. This time, Bob's new tool is on us.

We liked Bob Lasley's Top Shop Tip so much, we're sending him a Ridgid tablesaw (model TS3650). Attaboy, Bob!

Top tips win tools!

Describe how you've solved a workshop dilemma and you'll earn $75 if it appears here. And if your tip garners Top Shop Tip honors, you'll also win a tool prize worth at least $250.

Send your best tips, along with photos or illustrations and your daytime telephone number, to: **Shop Tips, *WOOD*® Magazine, 1716 Locust St., GA-310, Des Moines, IA 50309-3023.**

You can also e-mail your tips to: **shoptips@woodmagazine.com**, or post them on the Top Shop Tip forum at **www.woodmagazine.com**.

Because we try to publish only original tips, please send your tips only to *WOOD* magazine. Sorry, submitted materials can't be returned.

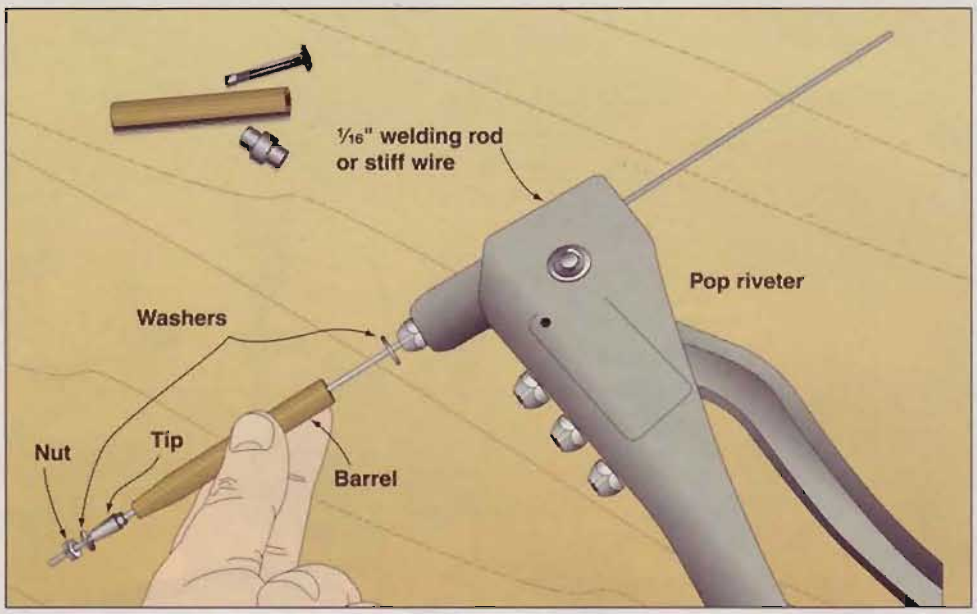
To pull a pen together, reach for the riveter

Thanks for the great article on pen-turning in *WOOD*® magazine issue #148 (page 80). I've been turning pens for years, and always found it awkward to assemble the bottom of the pen in a vise, as shown on page 83 of that issue. So instead, I use my pop riveter, as shown in the drawing.

I thread one end of a length of 1/16" welding rod and twist a nut onto the end to act as a stop. (You also could clamp a locking pliers on the end, if you don't want to thread the rod.) When it comes time to assemble a pen, I slip the rod through a small washer, the pen tip, the barrel, another small washer, and finally into the pop riveter. Squeezing the handle on the riveter draws the welding rod up, pulling all of the pieces together. When the assembly just starts to snug up, I make one last check to ensure that everything's properly aligned and then squeeze it into final position.

Resist the temptation to speed the process up by pulling all of the parts together at once. Although it is do-able that way, it's difficult. And, even if you succeed at adding all the parts one at a time, by the time you constantly readjust the parts, you won't likely have saved time.

—Vern Shellman, Beverly Hills, Fla.



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shop tips

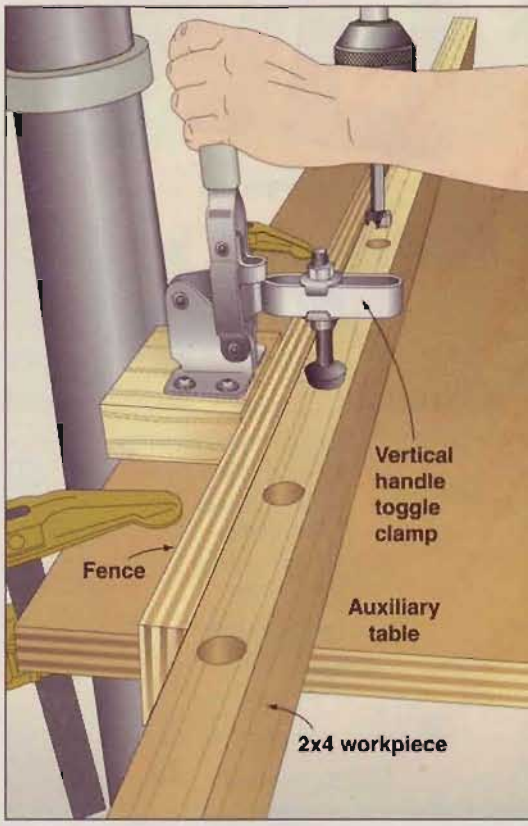
Toggle clamp puts a lock on hole spacing

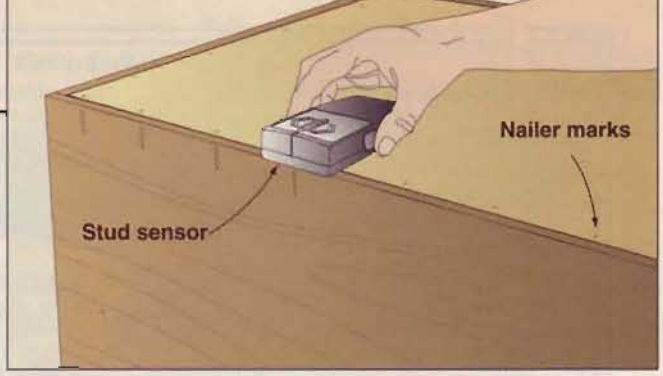
I had to drill 21 evenly spaced ¾" holes in each of 100 cedar 2×4s while making deck railings recently. Laying out and drilling all those holes and then sanding away the layout marks would take a lot of time, but a vertical-handle toggle clamp saved the day.

I mounted the clamp behind the fence on my drill press so the center of the clamp pad coincided with the hole center and was positioned the hole-spacing distance from the center of the drill bit. (Use twice the spacing distance if the clamp would be too close to the drill-press chuck.) I drew index marks on the fence to position the end of each board for the first hole (or first two holes for double spacing). After drilling the first hole (or two), it became simply a matter of locking down the toggle clamp with the pad in a hole. Besides serving as a stop, the clamp held the board firmly against the fence and table for safety.

The tapered pad on my toggle clamp fit perfectly into the ¾" holes. For other hole sizes, it would be easy to make the right size wooden tip with a lathe, hole-saw, or belt sander, and then attach it to the clamp in place of the pad.

—Scott Winkle, Cooksville, Ill.





Find empty brad holes with a stud sensor

When my brad nailer runs out of fasteners, it's hard to tell where the nailing stopped because the tool leaves an impression in the wood whether it drives a nail or not. To determine where to start again after reloading, I pass my density-sensing stud sensor along the fastening line. The sensor points to only the dimples that have fasteners in them.

—Marty Gerbasi, Sonora, Calif.

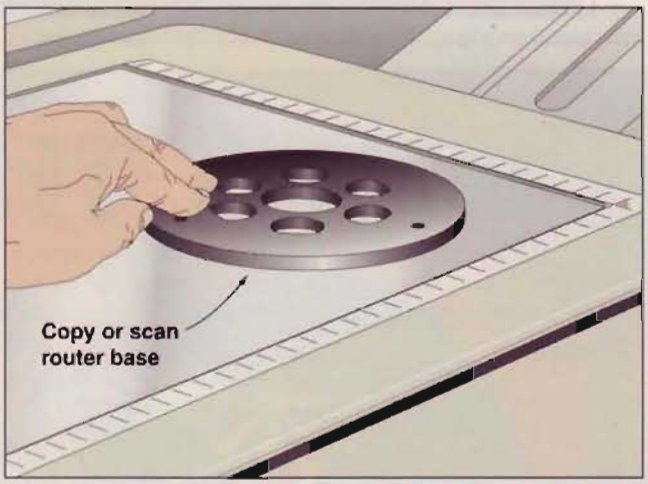
Get hole layout right by making copies

The tough part of attaching shop-made jigs and fixtures to a router is drilling the mounting holes to match up with the holes in the router base. I found an easy way to make a pattern of the router-base hole layout: Copy the router base on a photocopy machine.

After making the copy, check it against the tool base to make sure it's exactly the same size. (Some copiers are off by a few percent, so you may need to adjust the copier enlargement or reduction factor.) Once I have the pattern, I tape it or trace it onto my jig and drill the holes in the right places the first time. I sometimes need to reverse the pattern or make a mirror-image copy, depending on the way I plan to use the pattern.

I also make patterns using my computer's scanner. After scanning the base plate, I can flip the pattern with my drawing software if I need to. I can use the same software to mark exact centers in the holes. I stored the pattern file so I can print one out whenever I need it.

—Matt Besser, Urbandale, Iowa



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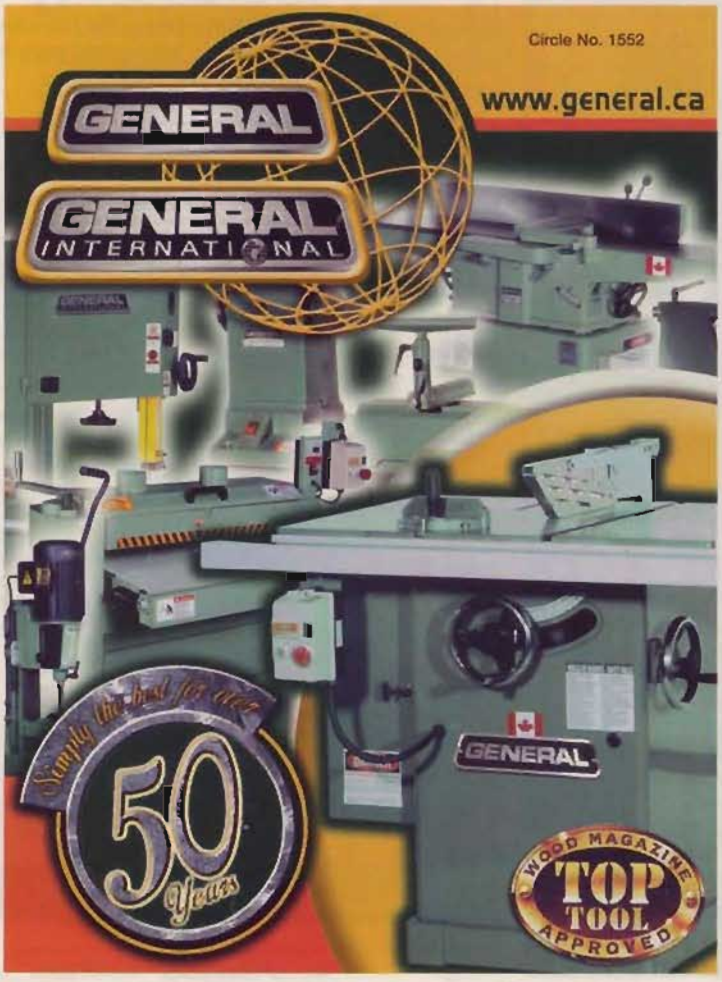

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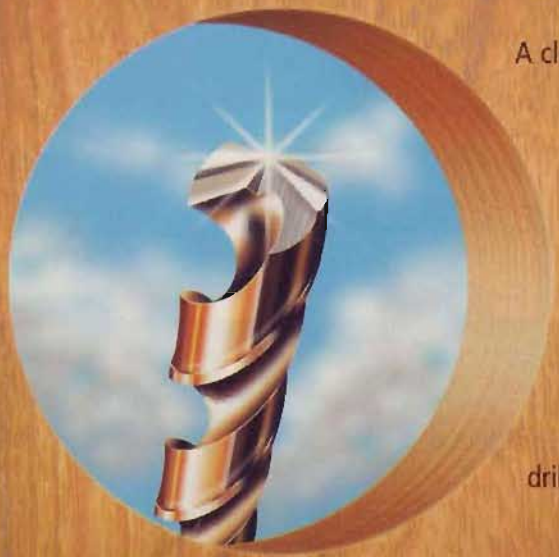

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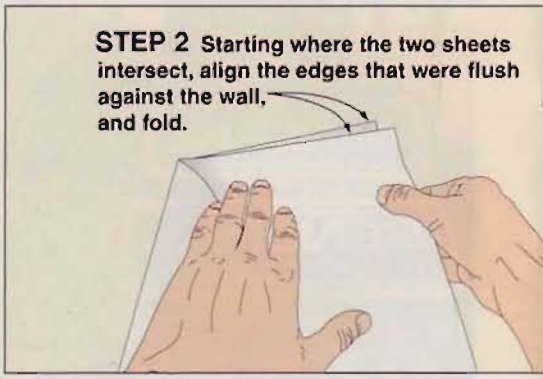
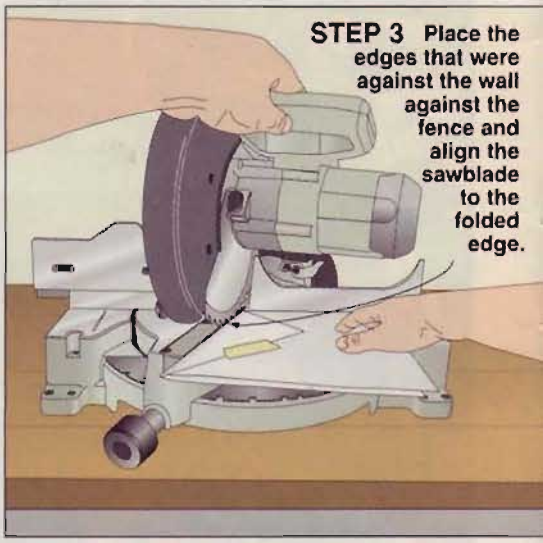
This job doesn't even start until the paperwork's done

When I have to miter-cut moldings to fit an odd-angle corner, a little paperwork makes adjusting the mitersaw a snap. Use the three-step process, shown *below*, to get perfect results every time.

Step 2 gives you a template of exactly half the angle between the two walls. After making the cut in Step 3, flip the template to the other side of the mitersaw fence, and swing the blade the other way to cut the mating part of the joint.

—Earl McGilvray, Sharpsburg, Ga.





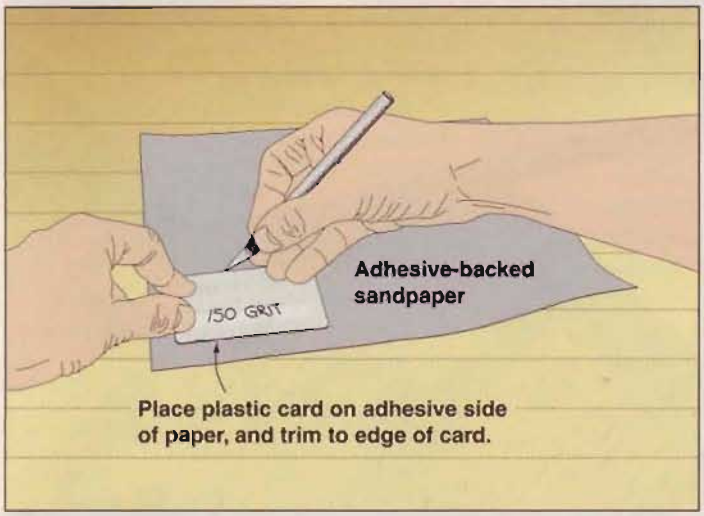
Put sander on a credit card, but don't worry about a bill

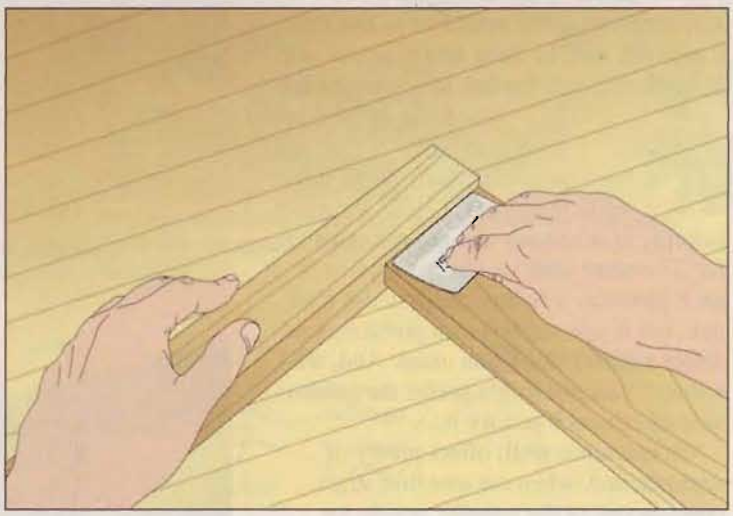
When my sanding block proved too large for the aprons on a small table, I grabbed one of those credit cards that so often arrive unsolicited in the mail. Instead of slapping it down to buy a sander, however, I cut a piece of adhesive-backed sandpaper to size, as shown *below*, and stuck it to the back of the card. Then I wrote the sandpaper grit on the front of the card with a felt-tip marker.

The thin, flexible plastic let me sand right up to the table legs more easily and evenly than I could have with my fingertips. The card's four edges last through a lot of sanding, and the plastic is easy to cut to shape for custom sanding blocks. If you don't receive enough unwanted cards in the mail, use your expired credit cards.

—Nathan Dixon, Fort Fairfield, Maine

See a new shop tip daily at www.woodmagazine.com/tips





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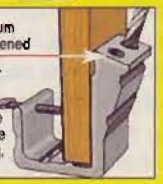

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Try the look of ash, and save some cash

Q: As I was admiring a friend's door, he informed me that it was made of ash. I would have bet that it was red oak. Is there any problem with substituting ash for oak in my projects?

—John Scott, Indianapolis

A: No problem at all, John. As you see in the photo at *right*, the grain patterns of white ash and red oak are similar. The same stain or topcoat applied to each produces a lighter result in ash than oak, but if you see that as a problem, just select a darker stain than usual. And, who knows? You just might prefer the golden tone of ash once you try it.

Ash machines well; offers plenty of strength; and, when cut into thin strips, ranks as one of the premier woods for making bent laminations on a form. Even better, white ash beats red oak at the cash register. We found ash priced at $2.28 per board foot at our local lumber outlet, while red oak cost $3.44. That's a 33 percent savings, the kind of difference that really adds up on a large project.

At the lumber store, we quickly found white ash and red oak boards that bore a strong resemblance to one another in grain size and pattern. Though not identical in color, they weren't far apart after a coat of Zar Provincial #114 stain.

A left-tilt tablesaw looks like the right way to go

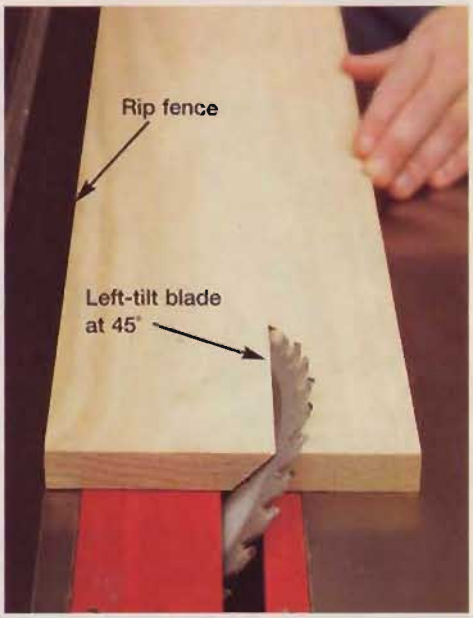
Q: I'm shopping for a tablesaw, and wondering whether I should choose a left-tilt or right-tilt model. Which do you recommend, and why?

—Clark Howard, San Diego

A: You'll get used to whichever one you buy, Clark, but at *WOOD*® magazine we prefer the left-tilt style. Most of us are used to working with the rip fence to the right of the blade, and a left-tilt saw leans the blade away from the fence. As you see in the photo and caption at *right*, that's a safer arrangement than you get with a right-tilt saw and a standard rip fence arrangement. Of course, you can move most (but not all) rip fences to the left side of your blade to achieve the mirror image of this set-up with a right-tilt saw. However, that forces you to use the fence in an unfamiliar way, which introduces a different kind of risk.

Manufacturers offer both left-tilt and right-tilt options in many cabinet saw models, so it's easy to find what you want. For example, of the seven tablesaws tested in issue 151, three offer a choice of tilt direction. (One of the others has a right-tilt design, and the remaining three are left-tilt saws.) Before you make your decision, also consider these factors:

- A left-tilt saw throws off your measurement scale when you use a stack of dado blades or even a thin-kerf blade. The blade or blades mount between the arbor plate and the fence, so the blade-to-fence distance can vary.
- The motor and its cover sit at the left end of a left-tilt tablesaw, where they'll get in the way if you ever decide to add a sliding table.
- The tilt-adjustment wheel is on the right side of a left-tilt saw, and the left side of a right-tilt model; one location might strike you as more convenient than the other.



When you bevel-rip on a left-tilt tablesaw, as shown here from the rear of the saw, the piece under the blade is not trapped against the fence. The result? Less risk of kickback.

Continued on page 36

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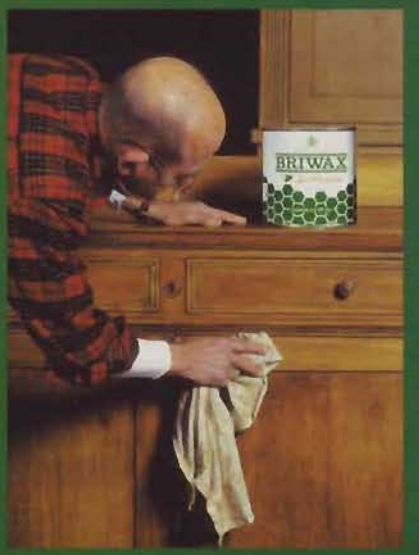

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Ease up, clean up when pilot bearing maakes a mark

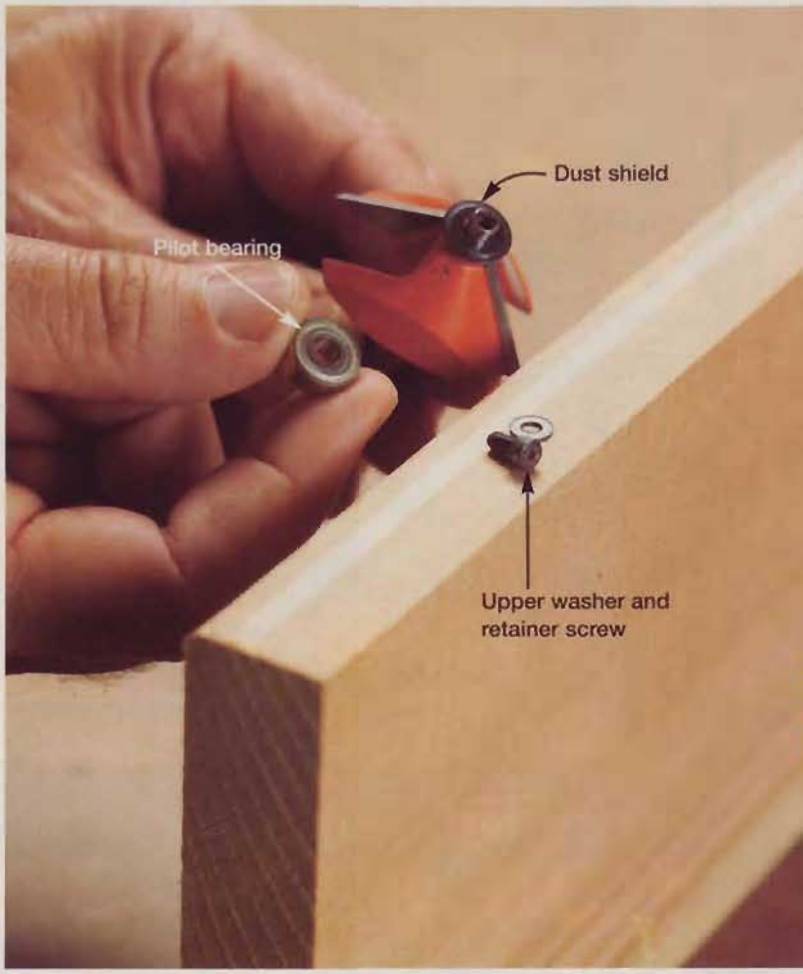
Q: When I use my favorite round-over bit, the bearing makes a groove in the wood. Am I just using too much pressure on the router, or is something else causing the problem?

—Jim Brady, Aurora, Colo.

A: It sounds as if you're pushing the router against the workpiece a lot harder than necessary, Jim. All you need is constant contact between bearing and wood on your final pass after making a lighter pass or two. However, you also should check on the condition of that pilot bearing. If it's not turning freely as you rout, it's more likely to leave a mark.

To disassemble the typical piloted router bit, remove the retainer screw at the end with an allen wrench, take off the small washer underneath, and pull off the bearing with your fingers. Use a cotton swab to clean any residue in the bearing's center hole. Some bits have a stepped dust shield that sits between the bearing and the bit's body; make sure the smaller-diameter portion rests against the bearing. If the dust shield is ever installed upside down, its wider surface contacts the outer portion of the bearing, impeding rotation.

It's virtually impossible to lubricate such a small bearing. If it has seized up, buy a replacement through your dealer.



A groove left by a pilot bearing shows up clearly in soft material, such as this cedar board. Use a small bottle brush or a bit of cloth dampened with light oil to clean the hole in the bearing.

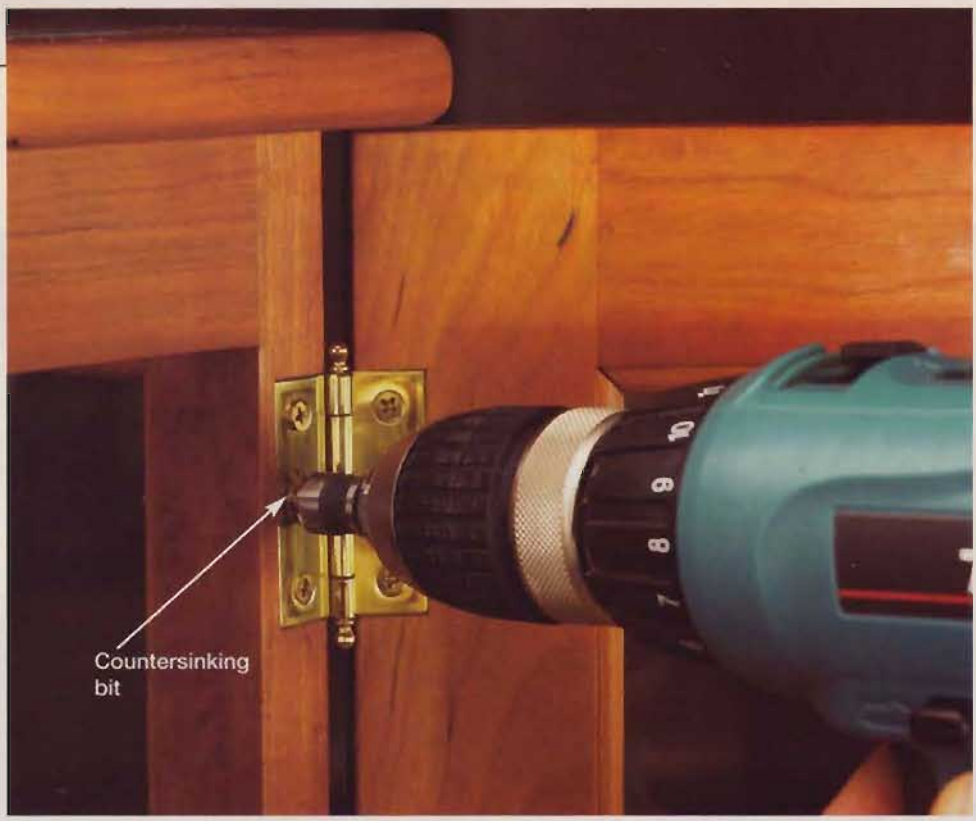
Door won't shut? Check those hinge screws

Q: I installed mortised butt hinges on my latest project, a small cabinet, and the door won't stay completely closed. Any suggestions?

—Steve Sullivan, Independence, Mo.

A: Assuming that the cabinet components are straight and square, Steve, it sounds like a hinge problem. Make sure the hinge surfaces are flush with the wood. If they are, the most likely culprit is one or more protruding screwheads. A screw might require a deeper countersink to seat flush with the hinge leaf, or it might be sitting at a slight angle.

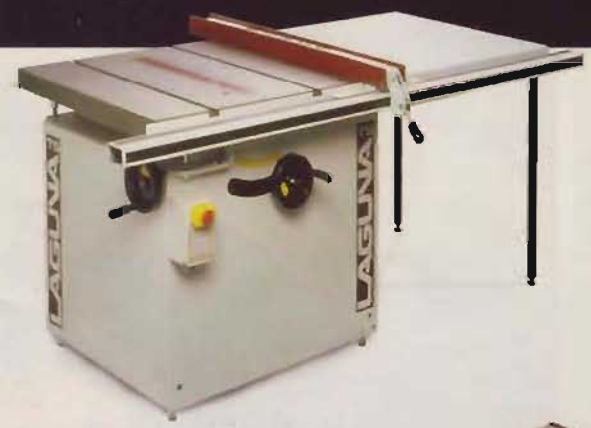
To take care of the first problem, see the photo at *right*. If the screw was driven at a slight angle, remove the hinge from the cabinet and glue a small dowel in the hole. Let the glue dry, and then replace the hinge. This time, be careful to drill a straight pilot hole, and reinstall the screws.



Enlarge a screw-hole countersink with an appropriately sized countersinking bit installed in your electric drill. Use a light touch, and check your progress frequently by matching the screwhead to the diameter of the countersink.

Continued on page 38

LAGUNA TOOLS



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Skinny biscuits lead to sloppy joints

Q I wind up with uneven joints when I use biscuits, and then I have to do a lot of time-consuming sanding. What can I do to avoid that?

—Larry Bair, via WOOD Online®

A Larry, you're probably seeing the result of either a slightly off-center slot setting or a mismatch between the width of the slots cut by your biscuit joiner and the thickness of your biscuits. If your biscuit joiner cuts the slots a bit above or below the center of your workpiece, it won't matter as long as you always keep the same side up on all pieces. But if you space your slots symmetrically along the joint line, and then one piece gets flipped, the pieces will still go together, but the joint won't be flush. Avoid that problem by marking the face of each workpiece before slotting.

As for mismatched slots and biscuits, note that the samples in the photograph show a difference of .010", which could produce a joint that's uneven enough to cause a problem. The biscuits will fill the slot after swelling with glue, but that won't fix a joint that's misaligned when you clamp it.

Investigate your own situation by using calipers to measure a couple of slots and several biscuits. If you find a lot of variation among biscuits, and if a number of them are .010" or more thinner than the slot, you might want to buy a different brand. (And you might want to put the calipers to those new ones before paying the cashier.)

As you use biscuits in your workshop, you might find some that are too thick for the slots. Avoid that problem by keeping the biscuits in a tightly sealed jar or plastic bag, to keep them from absorbing moisture. If you come across one that's too thick, you can make it thin enough to fit by tapping it with a hammer, or compressing it in your vise.

No matter which brand you settle on, make it a habit to check alignment after gluing and clamping a biscuit joint. Use clamps, cauls, or a mallet to make the joint flush before the glue sets up.

We found several examples like this when we experimented with one container of biscuits in the *WOOD*® magazine workshop. This degree of size variation results in a sloppy fit.

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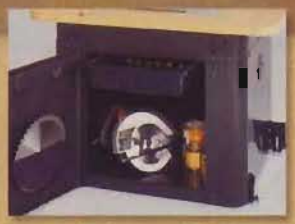

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Clean that drum sander, and learn not to burn

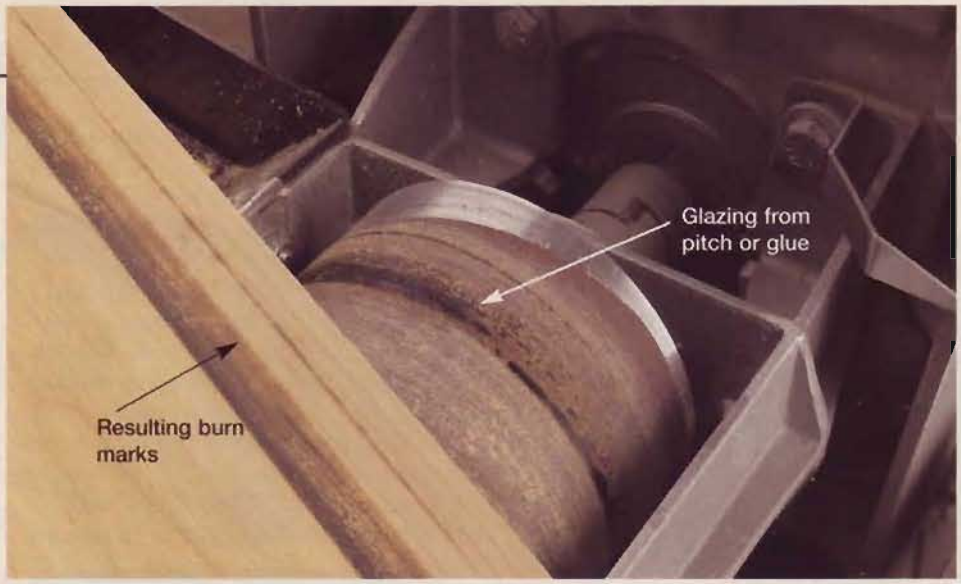
Q My drum sander burns narrow streaks in my workpieces. I make sure not to feed the stock too fast; what else could cause the problem?

—Kermit Pearson, Gowrie, Iowa

A Kermit, those streaks are burn marks caused by a stripe of hard, dark glazing on the sandpaper. This glazing results when pitch or glue accumulates on the sandpaper, and then turns hard under the heat and pressure generated by the sanding process. This area rubs your workpiece and burns it. To eliminate the problem, you need to replace the sandpaper or give it a good cleaning.

To clean the sandpaper, put on eye protection, open the drum sander cover, turn on the power, and hold a rubber cleaning stick against the surface. You can purchase one of these sticks from Klingspor's Woodworking Shop; call 800/228-0000 to order item BS99801, priced at $7.95. If the glazing remains, clean polyester- or cloth-backed sandpaper by soaking it in a mixture of 2 ounces of household cleaner, such as Murphy's Oil Soap, in 1 quart of warm water. When the glazed area softens, scrub the sandpaper vigorously with a stiff nylon brush.

To keep the problem to a minimum in the future, make it a habit to set your drum sander for light passes. Heavy cuts build up heat, which makes glazing more likely. Go with 1/64" when using sandpaper coarser than 100 grit. With 100-grit and finer sandpaper, ease up to 1/128". Also be sure to thoroughly scrape away all dried glue before running a workpiece through the sander.



When your drum sander develops a glazed streak off to one end of the drum, you might be tempted to avoid it by placing your workpiece toward the other end. But eventually it will be in the way, so you're better off cleaning it now.

Continued on page 40

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Treat your CA glue right, and you'll bond

Q: I have two problems with cyanoacrylate (CA or "super") glue. One, it sometimes doesn't bond well, even though I've coated one or both surfaces. And two, it sets up just great inside the applicator tip, forming a clog. Suggestions?

—Mel Lewis, Houston

A: Unlike other adhesives, Mel, you don't need to spread CA glue into an even coat. Buy a high-quality product, and then follow this rule of thumb: one drop per square inch of surface. Also, you'll usually have more success if you use some "accelerator," which should be available where you buy the glue. Spray the accelerator on the mating surface to speed the bonding, and you won't have to hold the pieces in position for more than a few seconds. Skip the accelerator if you know it's going to take time to position the pieces correctly.

As for the clogging, here are some recommendations from Satellite City, the company that makes Hot Stuff glue: Keep the tip away from the work surface so no sawdust particles or other foreign matter gets inside; replace the cap between uses to keep out dust and accelerator overspray; don't wipe the tip with a cloth or paper towel, although you can wipe it with a plastic bag; and don't insert a pin or nail into the tip, which can carry a trace of moisture inside and promote clogging. Also, as the glue ages, it becomes more likely to clog, and its shelf life relates to the container size. The manufacturer claims a shelf life of six months for Hot Stuff in a ¼-ounce container, and more than a year in a 2-ounce container.

If you spread CA glue like other glues, it tends to remain liquid. Apply separate spots of CA glue, as shown here, to produce the instant bond that you want.

Got a question?

If you're looking for an answer to a woodworking question, write to **Ask WOOD, 1716 Locust St., GA-310, Des Moines, IA 50309-3023**, or send us an e-mail at **askwood@woodmagazine.com**. For immediate feedback from your fellow woodworkers, post your question on one of our forums at **www.woodmagazine.com**.

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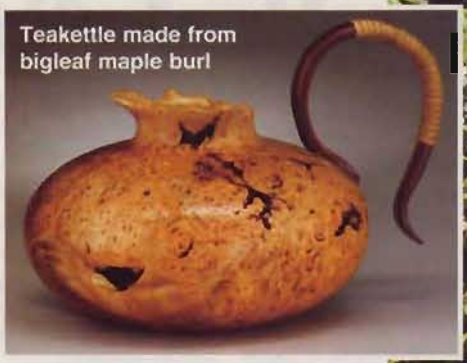
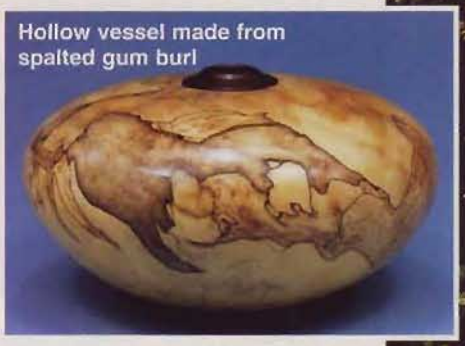
how to find the pearls in burls


Teakettle made from bigleaf maple burl


Hollow vessel made from spalted gum burl

In the photo, *right*, a red maple tree bulges with burls. Though eerie on the outside, these growths yield beautiful figure, as evidenced in the turnings *above* by Bruce Hoover.

Burls—those odd, bulbous growths on trees that result from an injury or disease—hold hidden treasures of exotic figure beneath their haunting exteriors. For a woodworker, this figure makes for eye-catching turnings; accents such as inlays, box lids, and handles; and veneers. To get the most from burls, you need to know how to properly cut and preserve them. Bruce Hoover, an award-winning professional woodturner from Virginia's Eastern Shore, knows burls inside and out. He shares his tips *below* on preparing these prized beauties.

Start with the harvest

When you're lucky enough to come across a downed tree with burls (and you have permission to take them), cut oversize sections that include a minimum of 6" of trunk material above and below the burls. The extra wood, Bruce notes, will protect the burls from drying too quickly and checking. To save as much of a burl's figure as possible, avoid slicing the burl from the trunk. However, if a trunk section is too large to handle, you can cut through the pith to remove the back half of the trunk, reducing its size and weight.

Author Bruce Hoover shapes a large hollow vessel from spalted box elder, characterized by the fungus-induced red streaks.

For extremely large burls, you may be better off cutting them into more manageable sections or slabs for transport, again allowing extra material, where possible, for drying and mounting on a lathe or later slabbing into box material or some other project.

For faster drying, trim and size the burls

To speed up drying, cut the burls that you plan to use in the near term into rounds and blocks for turning or boards and veneers for other woodworking purposes. (See "3 easy steps to prepare a round," *page 44, bottom.*) If you're not in a hurry to use the burls, leave them whole for storage. Allowing them to dry slowly can produce spalting and color change that adds additional character, as you can see in the inset photos, *above*.

When cutting burls into boards, cut the boards 25 percent thicker than you'll need to allow for distortion during drying. Also, be aware that your cutting direction can make a difference in the figure's appearance, depending on the burl's grain pattern. Burls typically have either an eye figure or random, swirling grain. If you're cutting a burl with

Continued on page 44

eye figure, the board will exhibit either eyes or radiant lines depending on the way you slice it, as shown on the drawing at *right*.

How can you tell if the burl has eye figure? You can't be sure without taking a thin slice off the burl's top. But, you generally can expect to find eye figure in maple, cherry, ash, and walnut burls. If a burl has swirling grain (typical in mulberry, gum, and birch), you needn't be concerned about the cutting direction. Just cut it to get the best yield.

Seal and store your gems

In order to slow the release of moisture, seal the exposed end-grain surfaces on your cut pieces. (It's not necessary to seal any oversize sections or rounds that you plan to turn wet within 8 to 10 weeks.) Use a sealer, such as End Grain Wood Sealer, available from Packard Woodworks Inc. (call 800/683-8876, or go to www.packardwoodworks.com).

Now, store oversize sections outside, off the ground, and sheltered from direct sun and rain. Keep the cut pieces inside. How long will it take the cut pieces to dry? This varies with temperature and humidity conditions. As a general guide, Bruce has found that small rounds and blocks less than 1½" thick or boards less than ¾" thick dry in about 12 weeks in warm air. Thicker pieces can take up to 6 months.

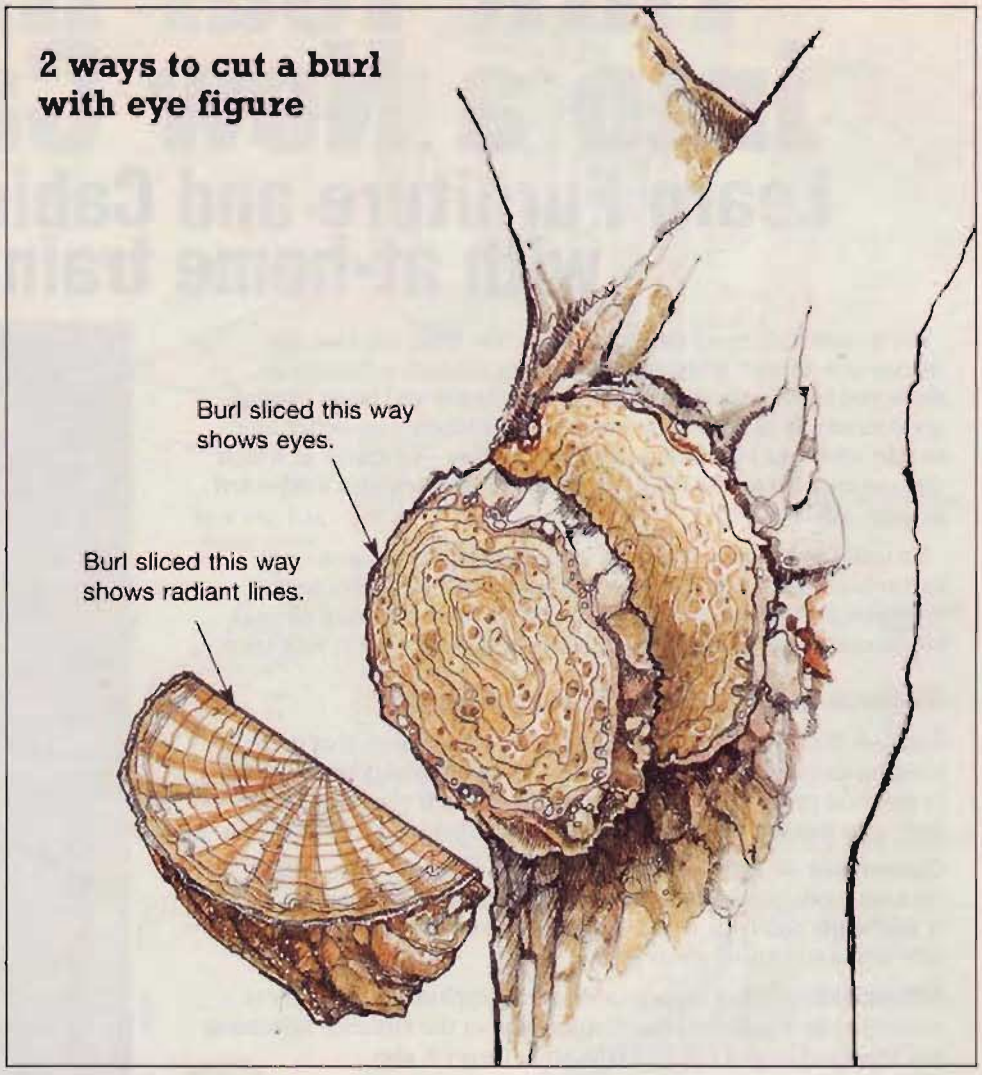


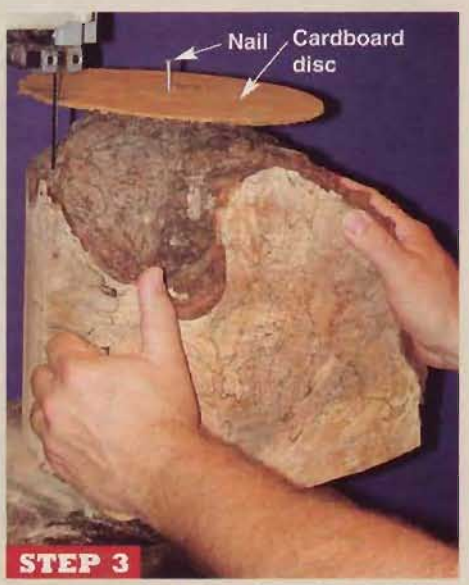
Illustration: **Mike Mittermeier**
Photographs: **David Dereng**

3 easy steps to prepare a round

In order for the weight of your burl to be evenly distributed when turning it on the lathe, you'll need to flatten its back and round its outside, as shown in these photos. Waiting about four weeks before turning the burl will allow initial moisture release to help stabilize the wood so there's less chance of distortion.

Chainsaw through the pith of the oversize section to remove the back half of the log while also flattening the back of the burl.

Trim the excess trunk ends, then chainsaw along the sides of the burl to square it, as shown here.



Nail a cardboard disc of suitable size for a cutting guide to the burl's top. Bandsaw the burl round, following the disc.

VISIT WITH A MASTER

all the right moves

Learn how craftsman Mike Jagielo creates award-winning projects with articulating parts.

Though clients go to professional woodworker Mike Jagielo for built-ins, furniture, and church fixtures, they often have no clue about his other talents. Longtime *WOOD*® magazine readers, however, recognize his unique skills. His amazing articulating projects have won many awards in this magazine's contests. But how does he do it?

Our curiosity took us to his shop in Almond, Wisconsin, to find out. While there, we gleaned a few insights on what makes his projects stand out from the crowd and wow all who see them.

He may be crawly, but this beautiful spider, complete with moving legs and eyes, is anything but creepy.

This woodworker's winning ways

If you're a betting man, put your money on Mike Jagielo just about any time *WOOD* magazine holds a woodworking contest. Mike's unique creations garner prizes year after year (though we judge entries "blind"—without knowing who submitted them), thanks to their ingenuity and impeccable quality.

"Grandpa's Tractor," shown with Mike at *left*, won Grand Prize (and a new Dodge pickup truck) in our 1998 "Build-a-Gift" contest. Discover how this amazing contraption works by reading "Inside Mike's most complicated creation," *page 49*.

Mike's "Row, Row, Row Your Boat" clock, visible at *left*, took second place in our "It's About Time" clock contest. Turn on the motor to make the fisherman rock and row, while four fish pop in and out behind the clock face.

Mike competed and won consistently in our legendary "Build-a-Toy" contests. The "Lazy-eyed Turtle," *opposite* and *right*, loped out the door in 1992 with three prizes: first-place professional, best pull toy, and best finish. The spider, *top right*, spun its way into our judges hearts to become a grand prize winner in 1994, while his crab pull toy, *below*, skittered in for a win in 1995.

This cute crab's legs and claws move, while his eyes practically pop out of his head as he rolls along.

Add personality for instant appeal

You can easily imagine, even without seeing Mike's creations in person, that they fascinate and ooze charm even when they're standing still. The ladybug, *opposite* and *next page*, begs to be handled, while the turtle's eyes and friendly grin simply suck you in. Even the spider, with its creepy legs and wicked pincers, looks so friendly that, had it come along, Little Miss Muffet would not have abandoned her tuffet.

This cartoonish amiability boils down to one thing: personality. In Mike's opinion, that's the key to his projects' success. "I always try to keep my designs, especially toys, lighthearted," he says. Discovering that these beautifully crafted pieces also move just seals the deal.

To begin the process, ponder, then put it on paper

To make his projects move, Mike initially mulls over ideas in his head. "I may spend a month thinking about concepts before I begin any actual design work," he says.

Once an idea "sticks" in his head, Mike makes rough sketches to hone the concept. From those, he produces full-size drawings, as seen in the photo, *below*. Mike doesn't

Mike Jagielo's projects all develop in the same way. After figuring out what he wants to build, he makes a full-size drawing, then templates, roughed-out pieces, and finally the finished product.

By tracing around his templates, Mike easily creates multiple pieces of exact size. He cuts them on his bandsaw and then sands the pieces to final shape and smoothness.

have any formal drafting training, but has taught himself how to create drawings that work for him.

Though this step takes time, he views it as critical to success. "In the drawings, I can size all of the parts, check clearances, and look for interference points. If I can make it work on paper, it will work when I build it."

Once he's finished with the drawings, Mike makes photocopies, and then cuts these apart to create templates for the various parts. He makes his templates, which are also visible in the turtle photo, *previous page*, from a variety of materials, including hardboard, plywood, and cardboard.

Using templates allows Mike to fabricate most of the parts without additional measuring. He simply traces the templates onto the wood, and then bores, routs, or cuts where indicated, as shown at *left*.

Mike's drawings also serve one more important purpose. They allow him to protect his designs. See the **Shop Tip**, *bottom left*, to find out how.

Shell halves flap, legs move back and forth, and eyes glance up and down as you pull this bug.

Keep it simple to manage moving parts

Though each of Mike's creations moves in different ways, they all share just a few similar parts that give them their articulating action. Take a look at "A few basic movements," *below*, to understand how each component functions.

Whenever possible, all components are made of wood. Occasionally, though, when clearances won't allow space for a wooden pushrod, Mike fabricates one from brass rod, as shown at *far right*.

Mike has devised other unique ways, as well, to make the parts he needs. "If neces-

SHOP TIP

Protect your original ideas

Mike Jagielo pours a lot of effort into his toys, so he copyrights his plans to prevent others from reproducing or selling them without his permission. Woodworkers can build the project, but can't claim it as their own design. Anyone can apply for a copyright, and it only costs $30. For more information, visit the United States Copyright Office Web site: www.copyright.gov.

If you build a mechanism, tool, or other object and want to prevent others from manufacturing and selling it, or designing and marketing a similar product, you'll need a patent. To get one, though, you'll spend a lot of time and money to prove the merits and originality of the piece. Learn more from the United States Patent and Trademark Office at www.uspto.gov.

A FEW BASIC MOVEMENTS

Mike Jagielo's toys function by turning one type of motion into another. That sounds complicated, but needn't be. Mike demonstrated by mocking up the assembly, shown *below*, that produces several types of movement from one rotating shaft.

Rotating shaft: Like an axle, this part rotates inside a hole, and drives other components. The shaft may get its power from a motor or from a wheel that rolls on the ground.

Cam: This circular piece gets secured to the rotating shaft. With its off-center hole, the cam's outer edge revolves in an eccentric arc.

Pushrod: Riding on the cam, this rod turns rotating motion into back-and-forth action to push and pull on another component.

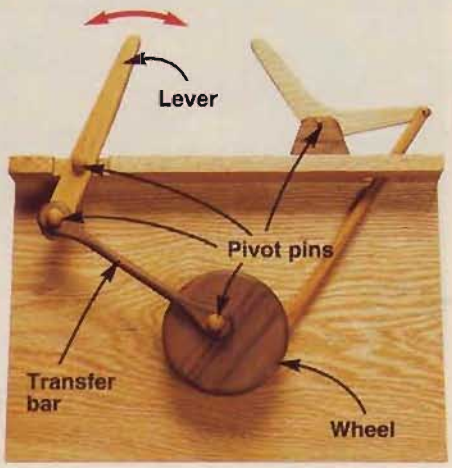
Rocker arm: When one end of the boomerang-shaped arm gets pushed and pulled, it rocks on its central pivot, causing an opposite motion at the other end.

Wheel: Secured to the shaft on a centered hole, the wheel often rolls on the ground to provide power to the shaft. An off-center hole in the face of the wheel can accept a pin to drive another component.

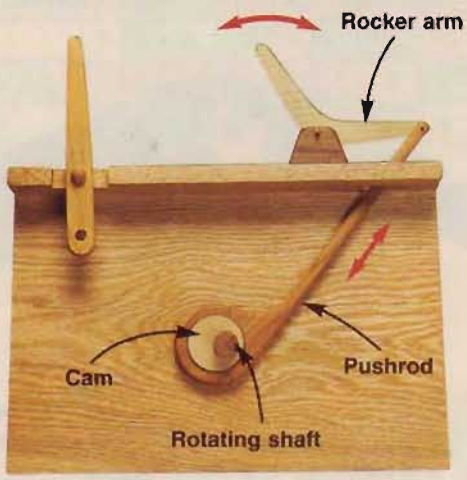
Transfer bar: Similar to a pushrod, this bar gets pinned at each end, and transfers motion from one end to the other. When pinned to a wheel, the transfer bar gets mounted off center.

Lever: The free end of this piece sweeps an arc that varies in size depending on where along its length the lever is pinned.

Pivot pins: These simply secure one component to another.



WITH TRANSFER BAR AND WHEEL



TRANSFER BAR AND WHEEL REMOVED

sary, I'll grind down a drill bit to create the exact size I need. Just because a tool isn't available off the shelf, that doesn't mean you can't create it yourself," he says.

Finishing touches take quality up a notch

No matter how well Mike's creations move, they wouldn't garner accolades and awards if they didn't look great. To that end, much time gets spent choosing woods, sanding, and finishing.

Mike shies away from stains on most of his pieces, choosing instead to mix domestic species, such as walnut, maple, cherry, and oak to create contrast. He often chooses easy-to-work basswood for carved pieces, such as heads. Those he sometimes stains an opaque white to eliminate grain lines. Or, he may use colored stain, as seen on the chicken, to lend colors not found in natural wood.

Before finishing, Mike spends a lot of time sanding. "Because many pieces are small, they're tough to work with on machines, so I do a lot of hand shaping," he says. He usually sands through 220 grit before applying oil finish to bring out the wood's rich color. Then, he sprays on a couple of coats of lacquer for protection.

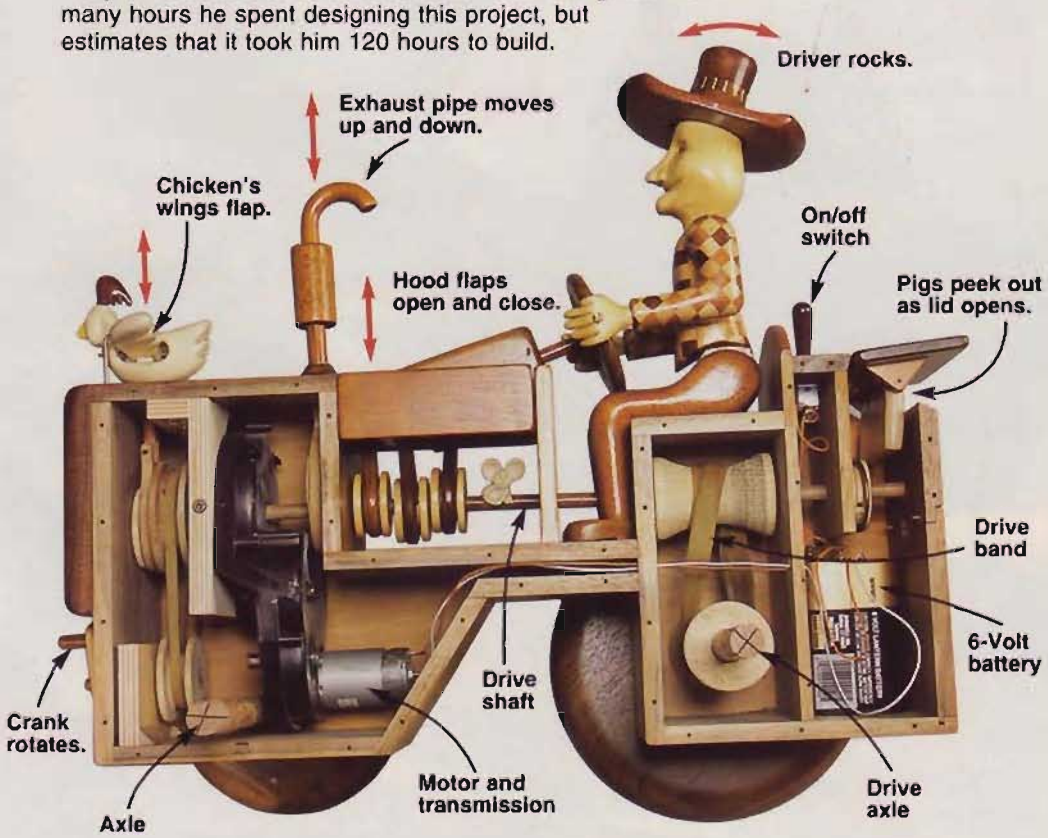
If you'd like to build toys such as these, Mike offers some advice in "Toying around," *below right*. But if you don't feel ready to design moving toys on your own, you're in luck. Plans for Mike's spider, turtle, and a fun-loving crab are available from Cherry Tree Toys at 800/848-4363, or www.cherrytreetoys.com. Once you try building one, we're sure you'll be moved to make more!

Written by **David Stone**
Photographs: **Dennis Nolan**

To create a brass pushrod, Mike inserts one end into a ⅛"-deep hole near the end of a closet rod. He pulls the rod around to create the radius, removes it from the pole, and nips off the starter end. The rod rides on a cam with a grooved edge, seen on the benchtop.

Inside Mike's most complicated creation

Mike pulled out all the stops when he created "Grandpa's Tractor." This 30"-long motorized marvel rolls bumpily along (thanks to off-center front wheels) while the driver, engine, and even the free-loading chicken move. Power comes from a battery-operated motor that originally served a child's ride-on toy. The motor turns a drive shaft, running from front to back, that activates all of the moving parts. They're detailed *below*. Mike doesn't venture to guess how many hours he spent designing this project, but estimates that it took him 120 hours to build.



Toying around

After seeing Mike's tantalizing toys, you may want to try making your own. He offers the following advice:

Start simple: You don't have to create multiple articulating points to make the piece move in interesting ways. Just one or two moving parts are necessary. Mike's first contest entry, for example, was an apple pull toy with two worms that popped in and out of holes.

Observe for inspiration: When devising your own designs, look for an object—perhaps a bug or an animal—and observe how it moves. Then decide if you can recreate that motion using simple shop-made components.

Don't ask for big movements: When he started, Mike often located holes on wheels, for example, too far off center. "I found out that it took too much force to overcome the resistance, so now I keep offset holes within a half inch, at most, from center," he notes.

Add personality: Make your toys irresistible even when standing still by including a silly grin, unique shape, or oddball quirk, just to keep it fun.

the shelf maker's complete guide

Let *WOOD*® magazine's master craftsman Chuck Hedlund guide you through the many choices for selecting, sizing, building, and installing shelves.

However simple a woodworking project may seem, it pays to plan ahead. Shelving is no exception. Any board supported at two points qualifies as a shelf, but you quickly run into questions: Which material and span dimensions work best? What supports should you use? What choices do you have for making the shelf look good and match its surroundings?

To steer you through successful shelf-making, we put together this guide. In the following pages, you'll find a chart covering 19 material and edging choices at five possible spans, 11 adjustable-shelf hardware possibilities, five options for placing fixed shelves inside a cabinet, pointers on attaching supports for wall-mounted shelves, and information about glass shelves. Whether you plan to build a formal bookcase for the living room or a place to store paint cans in the garage, you should find the answers to your questions.

Consider width, height, and spacing

Although shelves might hold a variety of objects over the years, tailor the dimensions to suit the first purpose you have in mind. To allow for spacing changes, use standards and brackets or shelf pins and a series of evenly spaced holes. (See *page 57* in the bookcase project article for instructions on accurately drilling shelf-pin holes.)

Custom-size shelving

Item	Shelf Spacing	Shelf Depth
Compact discs	6"	6"
VHS tapes	8"	6"
DVDs	8"	6"
Paperbacks	8"	8"
Hardbound books	11"	12"

Shelf depth, however, is a one-time choice. It typically depends on what you intend to store or display. Measure the objects that you want the shelves to hold, whether it's a TV, audio equipment, or small figurines. Take a look at the handy chart *above* for the spaces that a few common items require.

For the height of your shelves, make sure they are within reach of the people who will use them. In general terms, a convenient maximum shelf height for adults is 68" above the floor; for teen-agers, 61"; for middle-schoolers, 55"; for kindergartners through third-graders, 51"; and for preschoolers, 48".

If you plan to use the shelves for electronic components, allow extra space for wires and cords, and provide holes to run cords between shelves or to a wall outlet. An electrical plug requires a hole at least 1¼" in diameter.

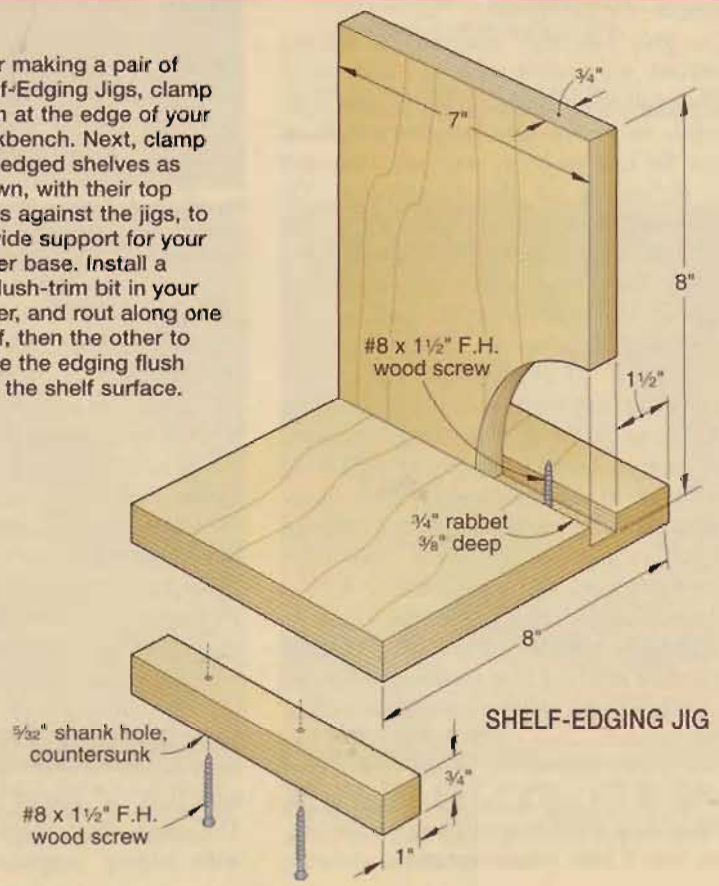
The front edge of the shelf says a lot about your work

Let's start our materials discussion with the subject of edging. As you'll see later, solid wood glued to the full length of a shelf's front edge adds a great deal of strength. It's also essential for appearance's sake when you use plywood. And, edging made wide enough to extend below a ¾" shelf adds visual weight, which lends a solid, sturdy feel to large bookcases.

If you choose to apply edging, use ¾" stock cut to an appropriate width. The wider the edging, the more strength you add. Rely on a simple butt joint and yellow glue to secure the edging to the shelf. Also make sure the edging is slightly proud of the shelf's top face when you clamp it up. After the glue dries, trim the edging perfectly flush with the top face by using a flush-trim bit in a handheld router. See the box *below* for a simple jig that helps you complete this task without damaging the shelf surface.

How to flush-trim edging in a flash

After making a pair of Shelf-Edging Jigs, clamp them at the edge of your workbench. Next, clamp two edged shelves as shown, with their top faces against the jigs, to provide support for your router base. Install a ½" flush-trim bit in your router, and rout along one shelf, then the other to make the edging flush with the shelf surface.

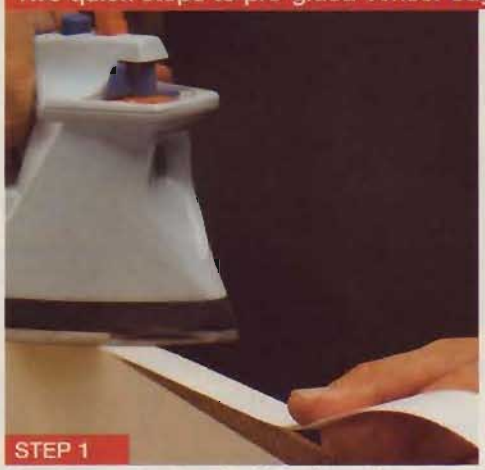


When you use a solid-wood shelf, or apply wood edging to sheet goods, you have a wide range of profile possibilities. A simple round-over softens the appearance of the shelf, and a chamfer adds a bit of visual interest.

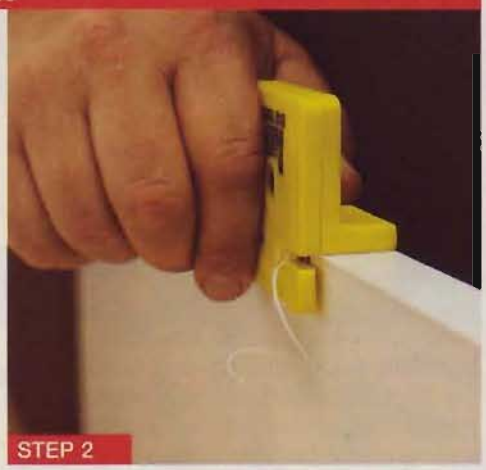
For elegant or classical projects, use an edge-forming router bit that suits your design. Use a series of light passes on your router table to shape the profile after applying and flush-trimming the edge.

For a quicker way to dress up the front edge of a shelf made with plywood or other sheet goods, simply attach flexible, pre-glued wood or melamine veneer. See the photos at *right* for the correct procedure. Visit a home center for this type of veneer, which adds no strength to the shelf, but quickly covers a raw, unattractive material edge.

Two quick steps to pre-glued veneer edges



Attach pre-glued melamine, shown here, or pre-glued veneer with an ordinary household iron. Uncoil the strip, and center it on the shelf edge. Set the iron to medium heat, press it against the veneer, and move it slowly along the shelf edge to melt the glue.



Wait a few minutes for the glue to cool and set, and then trim the overhang from each side. It's an easy job with a special edge-veneer trimmer. This Band-It trimmer from Woodcraft sells for $9.99. Call 800/225-1153, and order item 129119.

Choose a tough-enough shelving material

Almost any form of sheet goods or solid lumber can serve as a shelf, given enough support points. However, the choice of material becomes all-important when you support a shelf only at the ends. To evaulate differences in strength, we performed a test. See the photo at *right* and "The smart builder's shelving selector," *opposite*, for the results.

To give our test materials a serious workout, we loaded each 11"-wide shelf with a full set of encylopedias—that's 64 pounds of books. We left the weight in place for half an hour, and then measured the deflection at the centerpoint. Of course, photographs or lightweight collectibles would place only a fraction of this load on your shelves. But it's a good idea to build in extra strength, just in case future usage requires it.

We tested 10 of the materials in two ways: with and without a ¾×1¼" edging glued onto the front of the shelf. We used oak, pine, and poplar for edging, matching the choice to the shelf and its most likely setting. In many cases, edging reduced sag by half or more. (The wheat stalk fiber shelving comes from the factory with a bullnose profile that's not adaptable to front edging.) We used the same shelves at each span to avoid any variations in quality, cutting them shorter for each round of the test.

We didn't include all of the options, of course. If you add a second edging at the back of any shelf or a stiffener on the bottom, you'll beef it up even more.

How we measured shelf deflection

To check deflection for each shelving choice in the chart *opposite*, we placed a straightedge on the shelf, and then measured the gap at the center. We decreased the width of this mock shelving unit after each round of tests, cutting our shelf samples to fit at varying lengths.

Overall, ¾" Baltic birch with poplar edging outperformed all of the others, even the solid woods; it refused to sag over a 42" span. The main disadvantage of Baltic birch is availability. You're more likely to find it at a specialty woodworker's store or lumberyard than at a home center.

Somewhat surprisingly, edged pine beat out edged oak as the next one to achieve a zero-sag rating, that coming at 36". However, oak performed better than pine in the unedged categories.

Edged or not, none of the tested materials gave satisfactory results over a 48" span. If you need shelves of that length to hold books or other heavy objects, laminate two ¾" pieces together to make a 1½"-thick shelf. At 42", the solid woods with edging sagged approximately 5/64" (1/16") at the centerpoint, which is visually acceptable. (The eye will notice a sag of roughly 1/32" per running foot.) Consider, however, that a permanent installation probably would sag more over time.

When we tested our shelves at 36", often considered the maximum span for unedged material, sagging remained a problem for most of our shelves. Edged pine remained flat, however, and solid oak, both edged and plain, stayed within acceptable limits.

Edged oak plywood and edged medium-density fiberboard (MDF) become feasible choices at 30". By the time we shortened the span to 24", the notable entries were the ones that still failed to stay flat: particleboard, oriented-strand board, and wheat stalk board.

The smart builder's shelving selector

Note: All shelves measured 11" wide before the addition of edging.

Match the shelf length you want with the material you're considering. The result tells you how much in inches our sample sagged in the center while bearing a 64-lb load. (Edging is ¾×1¼" hardwood.)

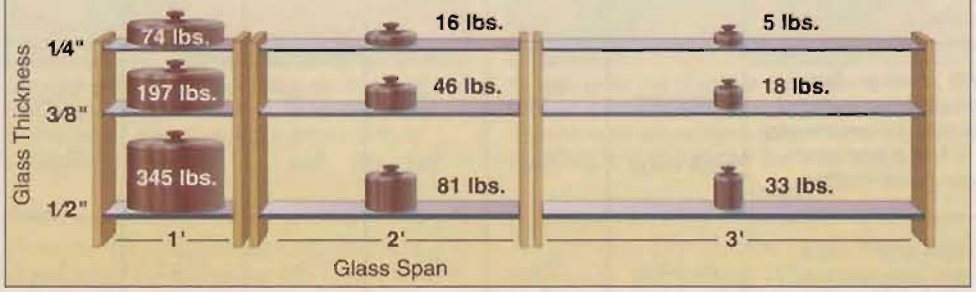
material	you need to know	edging difference	shelf span 24"	32"	36"	42"	48"
			amount of sagging in inches over shelf span				
¾" wheat stalk	This option looks good for utility purposes, with its painted bullnose edge. We found it priced at about $11 for a 1×8' piece. It needs a lot of support.	no edge	5/64	11/64	19/64	34/64	52/64
¾" melamine	Even with an edge, this common shelving material developed a noticeable sag at 36". A 4×8' sheet costs $25 at our home center.	no edge	3/64	9/64	19/64	33/64	52/64
		oak edge	1/64	5/64	8/64	16/64	26/64
¾" particleboard	With a solid-wood edge added, this inexpensive material ($11.50 per sheet) can handle medium loads in a garage or workshop.	no edge	7/64	15/64	27/64	44/64	1
		pine edge	0	5/64	6/64	12/64	18/64
¾" particleboard with plastic laminate	A simple layer of plastic laminate (about $2 per square foot) on each face adds a surprising amount of strength to particleboard.	no edge	1/64	5/64	10/64	17/64	30/64
		oak edge	0	4/64	8/64	12/64	21/64
¾" oriented-strand board (OSB)	When you make rough shelving, note that medium-cost OSB ($27 per sheet) offers more strength than particleboard.	no edge	5/64	8/64	9/64	18/64	27/64
		pine edge	1/64	4/64	6/64	10/64	15/64
¾" medium-density fiberboard (MDF)	MDF is comparable to the other manufactured sheet goods in strength, but has a smooth surface. Our sheet cost about $20.	no edge	3/64	9/64	15/64	32/64	47/64
		pine edge	2/64	2/64	6/64	12/64	21/64
¾" oak-veneer plywood	With an edge, this choice gives you furniture-like appearance along with visually acceptable deflection up to 36". It's expensive, at $40 per sheet.	no edge	1/64	4/64	7/64	7/64	7/64
		oak edge	0	3/64	5/64	7/64	7/64
¾" Baltic birch plywood	This is the winner of our strength test. However, its face has a bland appearance in comparison to solid wood, and we paid a hefty $46 for a 5×5' sheet.	no edge	0	4/64	6/64	10/64	15/64
		poplar edge	0	0	0	0	6/64
¾" solid oak	There's no need for edging unless you build shelves in the 48" range. But it's expensive: $5.50 per board foot at our home center.	no edge	1/64	1/64	3/64	9/64	20/64
		oak edge	1/64	1/64	2/64	4/64	13/64
¾" solid pine	With an edge, it performs as well as oak, and we paid only $1.50 per board foot.	no edge	1/64	5/64	9/64	15/64	20/64
		pine edge	0	0	0	4/64	7/64

For a light, bright look, try glass shelves

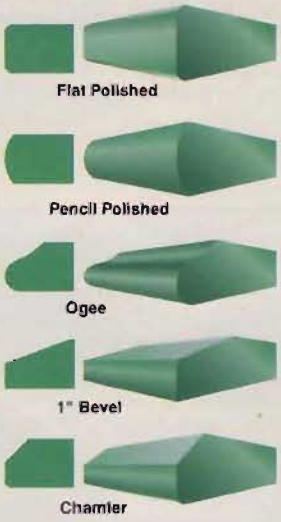
Some display cabinets are more attractive with glass shelves rather than wood. See-through shelving creates a light, airy look and focuses attention on the objects on display. Glass shelving is easily supported with shelf pins or lightweight standards and snap-in brackets. If you consider glass, here's what you need to know about strength and profile options.

AVOID A SHATTERING EXPERIENCE

Here's the maximum load, in pounds per square foot, for annealed glass used as shelving and supported at each end.



NO ROUTING REQUIRED



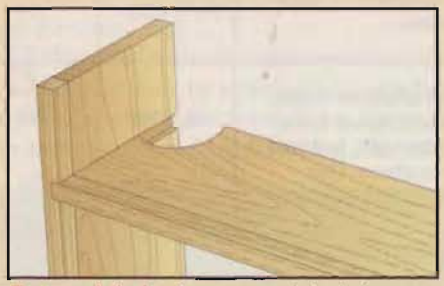
Most glass suppliers offer several edge profiles, such as these, that make great-looking shelves. Choose between a greenish tint in the edge or a nearly clear appearance.

Build in muscle with fixed shelves

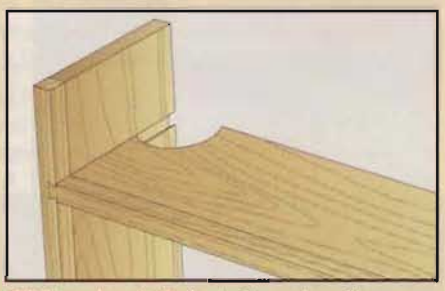
When you're quite sure about shelf spacing and don't expect to change it to suit different items, you might choose to build a cabinet with fixed shelves. Such shelves not only give the shelving unit a well-built look, but also add strength and stability.

Select among the options shown in these drawings when you build a cabinet with fixed shelves. Make your choice based on the style of the piece itself or to match surrounding furniture.

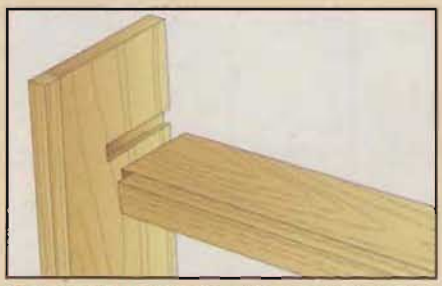
The key to any of these fixed shelf methods is to make certain that the supporting dadoes at either end of a shelf match perfectly. To do this, locate them exactly the same distance from the bottom of the cabinet side, and perpendicular to the edges. Avoid butt joints, in which nails, screws, or biscuits provide all of the support. It's worth the effort to cut dadoes, which give much more support over time. For less formal work, place a simple cleat under each end of the shelf. This approach works best when the cabinet side is made of plywood or another manufactured material, so you don't have to be concerned with the screws restraining its movement. Fasten the shelves to the cleats with screws driven from below.



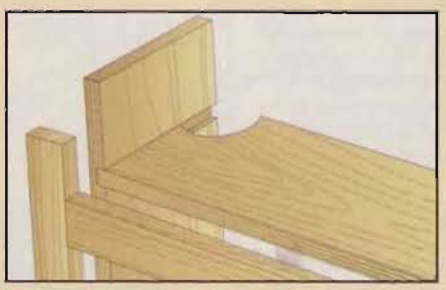
Exposed dado: An exposed dado is easy to make, and fills the bill on simple cabinets. However, hiding the dado helps the look of the cabinet, and is easy to do with a face frame.



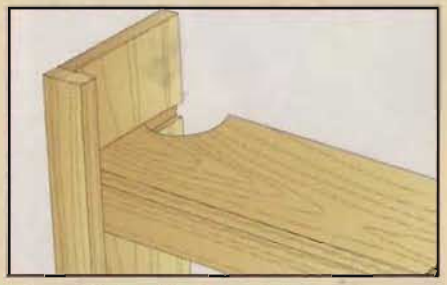
Sliding dovetail: A shelf made with a sliding dovetail supplies the unit with great resistance to racking, but it can prove fussier to fit than a standard dado. See issue 148, page 90, for pointers.



Stopped dado: Take a little extra time to make a stopped dado if a face frame doesn't suit your design. You'll need to cut a notch in each front corner of the shelf or, with edged shelves, simply adjust the length of the edging.



Concealed dado plus rail: With basic face-frame construction, it's easy to make through dadoes for shelf support, and then hide them with the stiles. A rail joined to the stiles covers the front edge of the shelf.



Concealed dado plus edging: A face-frame stile covers the dado, as in the drawing at *left*, but here a wide edging covers the shelf edge. This design produces the same visual weight, and adds interest with the stepped-back look.

Make sure to provide all the support needed

The array of shelf pins shown at *right* represents the tip of the iceberg when it comes to supporting the ends of adjustable shelves. We picked some of our favorites for applications from utilitarian to elegant. If you plan to cover the wall of an unfinished basement with shelves, choose the ones that cost the least. For small projects, the price differences are less important, and you should use whatever style seems appropriate.

Note that some brass pins come with brass sleeves for the pin hole. Sleeves might seem like a small detail, but they lend a much more finished look to your project. They hide the exposed plies if you're drilling into plywood, they keep the pins from pressing into the lower side of the hole, and a classy circle of brass shows at the surface.

Metal standards designed for clips mount on the surface of the cabinet side. To add a quality look to your installation, cut a shallow groove for each standard to sit in.

Tailor wall-mounted shelves to hold anything

Sometimes you'll want to place shelves on a wall instead of inside a cabinet. This approach can speed construction, save floor space, or allow for the storage of lumber or other long items.

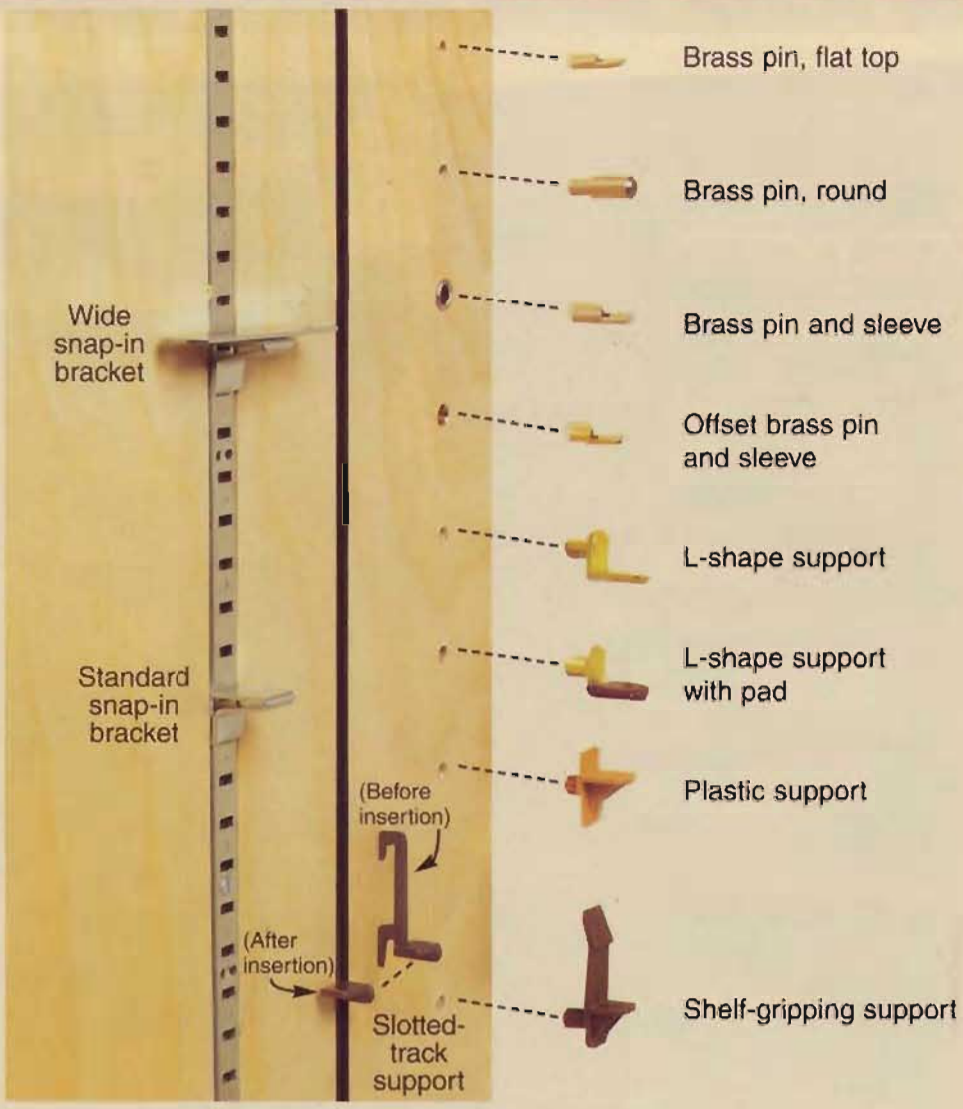
Wall-mounting makes it easy to increase the number of support points and increase the strength of the shelf. For shelving designed to hold lumber, paint cans, or other heavy materials, it's wise to place several brackets under each shelf, each one attached to a wall stud with the appropriate screws or nails. As a rule, use #12×2½" or longer screws for guaranteed strength. Check the bracket load ratings to calculate the number of brackets needed for your particular situation.

Slotted metal standards and brackets, such as those shown in the photo at *near right*, offer flexibility in shelf number and spacing. The double-slot design increases side-to-side stability.

Install larger brackets, such as the one in the photo at *far right*, in a permanent location for truly big jobs. For example, a set of these brackets will support a lot of lumber in your workshop.

Written by Jim Pollock with Jeff Mertz and Chuck Hedlund
Illustrations: Tim Cahill, Roxanne LeMoine

Adjustable support options



Two options for wall-mounted shelving

This double-slot design is rated at 360 lbs per bracket. Cut a groove into a strip of wood to enclose this standard for a more formal look. (Woodworker's Hardware, 7" bracket in white, item KV0182 WH 7, $2.48 each. Call 800/383-0130.)

This heavy-duty bracket snaps into the position shown to hold a shelf, and folds flat when not needed. The model shown has a 16" horizontal arm, and a pair together are rated for 750-lb loads. (Woodworker's Hardware, item KV206 ZC 16, $19.94 each.)

One bookcase, three

COVER PROJECT

Simply change the wood type and trim details to suit your taste. We'll show you how.

For the board feet of lumber and other items needed to build this project, see *page 62.*

Here's a masterpiece you can build that will showcase your treasured tomes for years to come. Simply build the basic case in the wood of your choice, and then add the traditional, country, or Shaker top and bottom trim. The bookcase, which measures 33¾" wide by 13" deep by approximately 6½' high, has a fixed shelf and three adjustable shelves to hold loads of books or display items. We used primarily oak and oak plywood for the traditional bookcase, cherry and cherry plywood for the Shaker unit, and knotty pine and knotty-pine plywood for the country look. But, you also can use less-expensive materials, such as solid poplar with birch plywood, particularly if you plan to paint the unit.

popular styles

First, build a case

1 Cut the sides (A) to the size listed in the **Materials List**. As explained in the **Materials key**, choose the plywood species that suits your bookcase style.

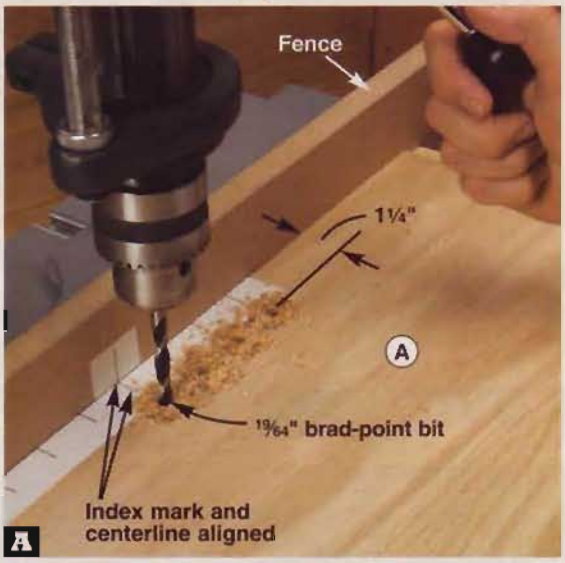
2 Using a dado-blade set adjusted to the thickness of your ¾" plywood, cut ¼"-deep rabbets on the inside face of the sides (A) at their ends, where shown on **Drawing 1**. Then, cut a ¼"-deep dado near the center, where dimensioned. Now, on the outside face of the sides, drill countersunk shank holes centered on the width of the rabbets and dadoes.

3 To drill the 19/64" holes on the inside face of the sides (A) for the shelf paddle-support sleeves, where dimensioned on **Drawings 1** and **1a**, first mark centerlines for the holes on masking tape along the sides' inside faces. Mark near one edge first, and then transfer the marks to the opposite edge using a framing square. (See the sidebar, *right*, for more information on the shelf support and sleeve hardware.)

4 Next, chuck a 19/64" brad-point bit in your drill press, and position the fence 1¼" back from the bit's center. Make an index mark on the fence centered with the bit. Then, aligning the marked centerlines with the index mark, drill 5/16"-deep holes in the sides, as shown in **Photo A**. Now, sand the sides with 220-grit sandpaper.

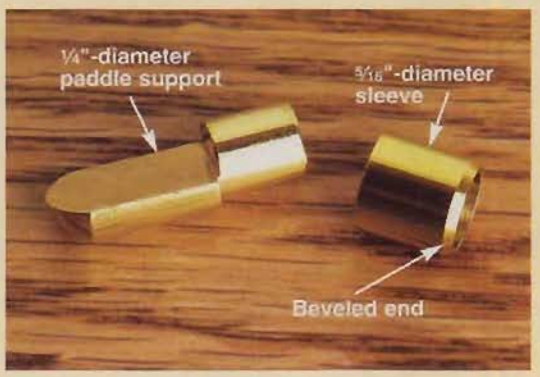
5 From ¾"-thick stock, cut four 1¼×71½" pieces to form the front stiles (B). Laminate the pieces to make a pair of 1½"-thick stiles.

6 Using the same dado-blade stack as before, cut a ¾" rabbet ½" deep along the back face of the stiles, where shown on



A

With the marked centerlines on the tape aligned with the drill-press fence's index mark, drill 19/64" holes 5/16"-deep in the sides (A).

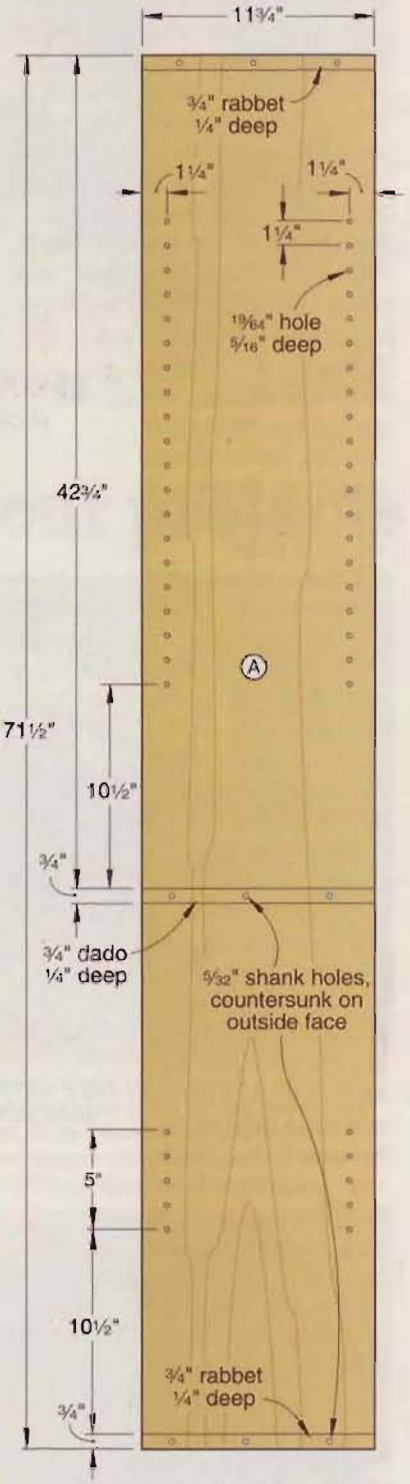


A case for shelf supports with metal sleeves

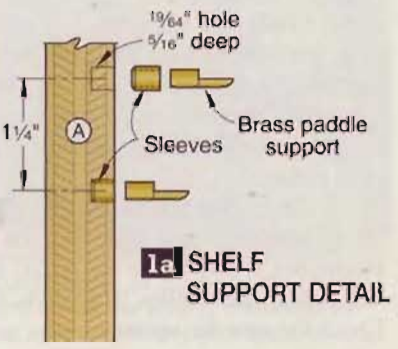
Ever been frustrated by shelf supports that won't stay in their holes, sag over time, or require pliers to remove? Holes that are worn or drilled slightly oversize to prevent binding cause the first two problems, and holes that are swollen by moisture or drilled slightly undersize to resist loosening cause the third problem. Here's a simple way to prevent these irritations. Use brass paddle supports with mating sleeves, shown in the photo *above*. The sleeves protect the holes from wear, and they provide a consistent fit with the supports so they're always easy to insert and remove. Another plus: The sleeves hide the hole walls, which can be unsightly, particularly in plywood.

To ensure the 5/16"-diameter sleeves stay snug in their holes, drill the holes using a 19/64" brad-point bit. To install the sleeves, insert their beveled end in the holes, and tap them in flush with a hammer. See **Sources** on *page 62* to buy the paddle supports, sleeves, and bit.

1 SIDE



(Inside face shown)



1a SHELF SUPPORT DETAIL

Drawing 2, Step 1, to receive the sides (A). Then, glue and clamp the stiles to the front edge of the sides, where shown on **Drawing 3**. When the glue dries, adjust the dado set to match your ¾"-thick stock, and cut a ¼"-deep groove along the inside face of the stiles, where shown on **Drawing 2, Step 2**.

7 Cut the top, fixed shelf, and bottom (C) and their accompanying rails (D, E, F) to size.

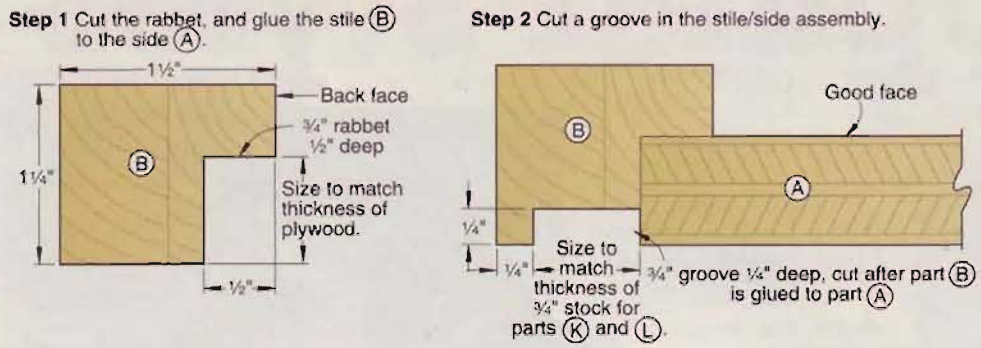
8 **For a Shaker bookcase**, lay out the curve on the top front rail (D), where dimensioned on **Drawing 4**. Then, bandsaw and sand the rail to shape.

9 **For a country bookcase**, make four copies of the top front rail/base front trim full-size partial pattern in the *WOOD Patterns*® insert. Next, draw a centerline across the width of the top front rail (D). Spray-adhere two copies to the rail, aligning them with the marked centerline, where shown on **Drawing 5**. (You'll need to trim one copy and flip it over to complete the contour.) Set aside the remaining copies. Now, bandsaw and sand the rail to shape, and remove the patterns.

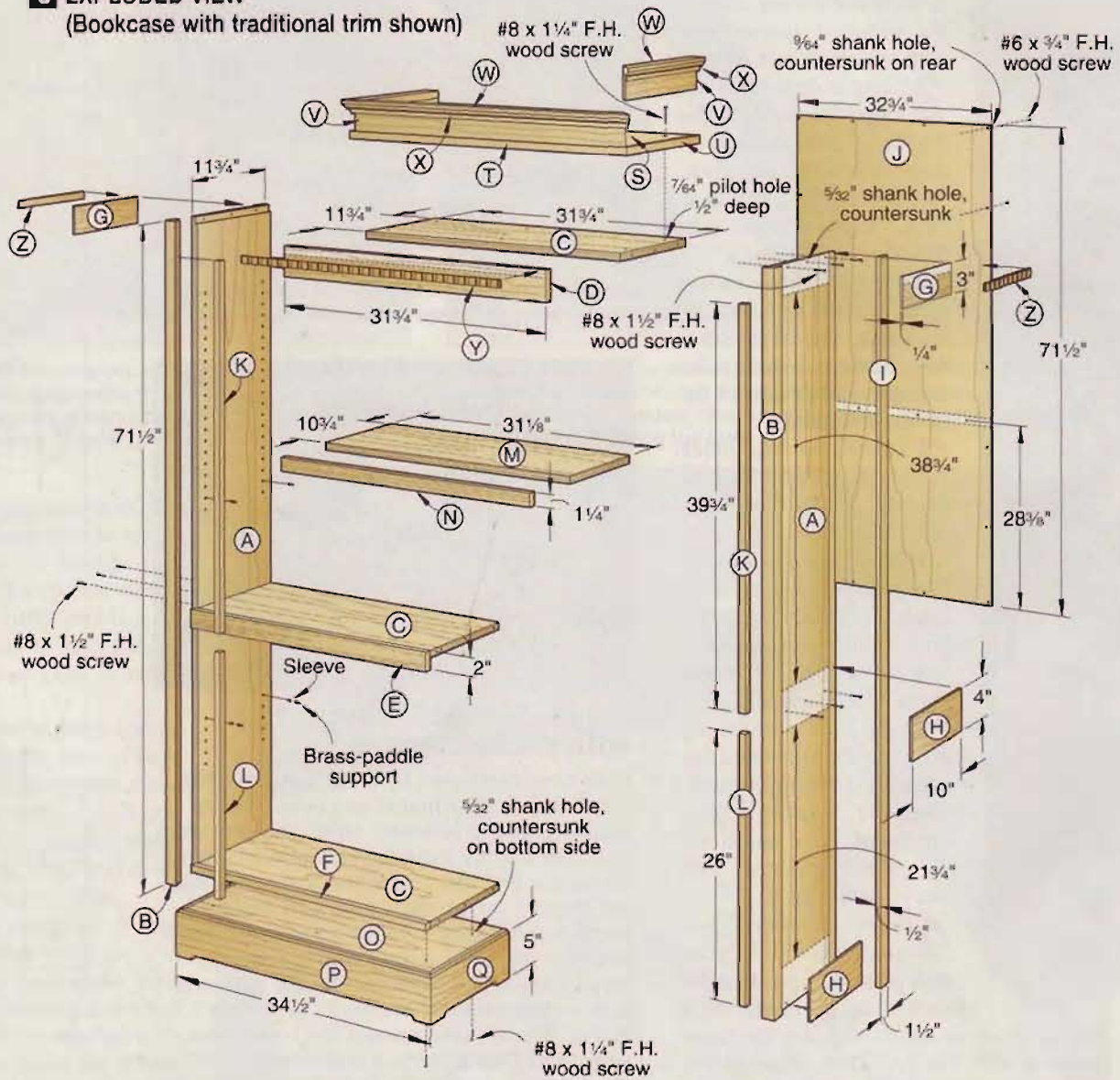
10 Glue and clamp the top, fixed-shelf, and bottom front rails (D, E, F) to the top, fixed shelf, and bottom (C), where shown on **Drawing 3**, keeping the rails' and panels' ends flush and the rails' top edge even with the panels' top face. Position the top panel's best face down and the fixed shelf and bottom panels' best face up. When the glue dries, sand the assemblies smooth.

11 Assemble the case by gluing, screwing, and clamping the side assemblies (A/B) to the top, fixed-shelf, and bottom assemblies (C/D, C/E, C/F). Check the case for square.

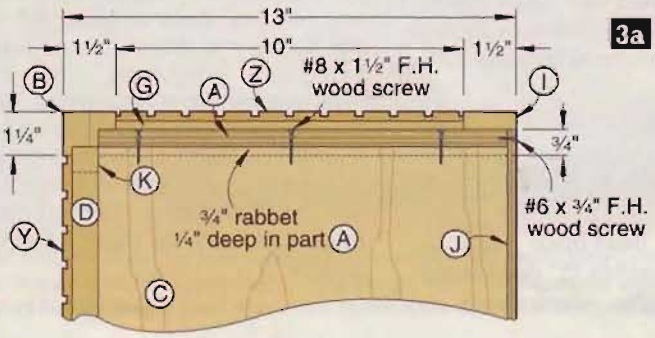
2 FRONT STILE DETAIL TOP VIEW


Step 1 Cut the rabbet, and glue the stile (B) to the side (A).
1½"
Back face
¾" rabbet ½" deep
1¼"
Size to match thickness of plywood.
½"
Step 2 Cut a groove in the stile/side assembly.
Good face
¼"
¼"
Size to match thickness of ¾" stock for parts (K) and (L).
¾" groove ¼" deep, cut after part (B) is glued to part (A).

3 EXPLODED VIEW
(Bookcase with traditional trim shown)

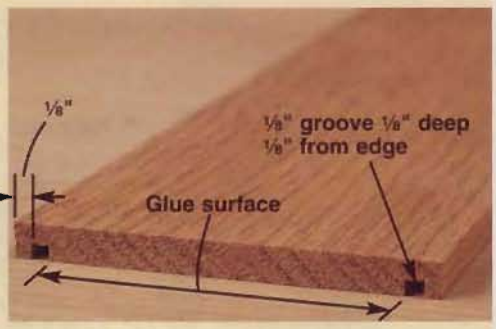


3a TOP SECTION VIEW

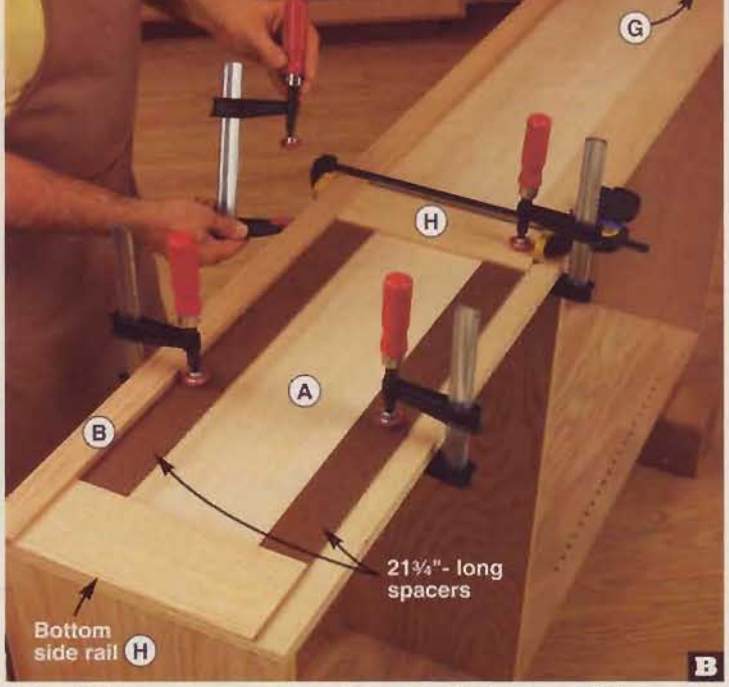


SHOP TIP

A "groovy" way to put the squeeze on glue squeeze-out



Removing excess glue when assembling parts is messy and risky. If you leave the slightest residue, it can seal the wood and block stain penetration, resulting in a blotchy finish. Here's a simple way to avoid the problem. Cut ⅛" grooves ⅛" deep ⅛" from a part's edges on its glue surface, where shown *above*. Then, apply glue to the area between the grooves, and clamp the part in place. The grooves will capture the excess glue, preventing it from oozing beyond the part's edges.



Using 21¾"-long spacers to position the middle side rail (H) above the bottom side rail, glue and clamp the rail to the side (A).

Now, complete the case

1 Cut the top side rails (G), middle and bottom side rails (H), and back stiles (I) to size. Sand the parts smooth. To avoid glue squeeze-out when mounting these parts, see the **Shop Tip**, *above*.

2 Glue and clamp the top side rails (G) and bottom side rails (H) to the sides (A), flush with their top and bottom edges, where shown on **Drawing 3**. Then, when the glue dries, glue and clamp the middle side rails (H) to the sides, as shown in **Photo B**.

3 Glue and clamp the back stiles (I) to the sides (A), flush with their ends and tight against the side rails (G, H). The stiles overhang the sides' back edges by ¼".

4 Cut the ¼" plywood back (J) to size. Then, on the rear of the back, drill countersunk shank holes, where shown on **Drawing 3**. Now, position the back on the case, drill pilot holes using the shank holes as guides, and drive the screws.

5 Cut the upper and lower fillers (K, L) to size to fit the ¾"-wide grooves in the front stiles (B). **For traditional and Shaker bookcases**, cut the upper filler (K) 39¾" long. **For a country bookcase**, cut the upper filler (K) 38½" long. Glue and clamp the fillers in place.

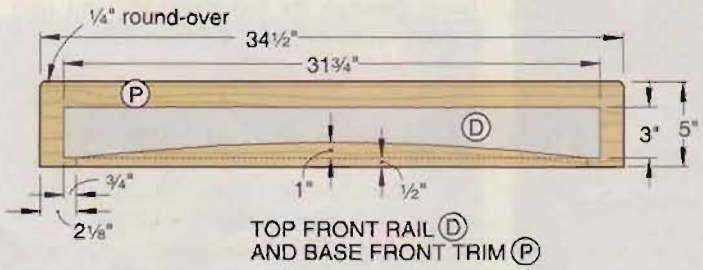
6 Cut the adjustable shelves (M) and shelf trim (N) to size. Then, glue and clamp the trim to the shelves, flush with their ends and top faces. Sand the shelves smooth.

Add the base

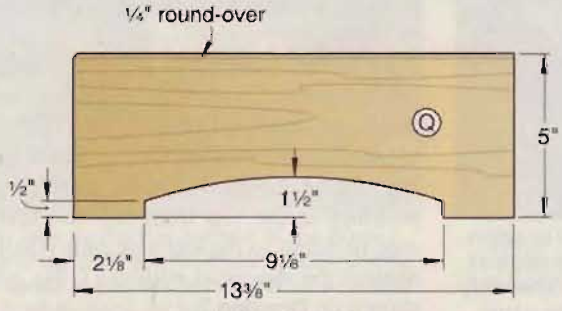
1 Cut the bottom panel (O) to size. Next, to form the front trim (P) and side trim (Q), cut a 5×65" workpiece from ¾"-thick stock. Then, rout the applicable profile along an edge of the workpiece. **For a Shaker bookcase**, rout a ¼" round-over where shown on **Drawing 4**. **For a country bookcase**, rout a ¼" chamfer, where shown on **Drawing 5**. **For a traditional bookcase**, rout a ¼" cove, where shown on **Drawing 6**.

2 Miter-cut the trim (P, Q) to length to fit the bottom panel. For the best appearance, maintain a continuous grain flow across the trim pieces, as laid out on the **Cutting Diagram**.

4 SHAKER TOP FRONT RAIL AND BASE TRIM

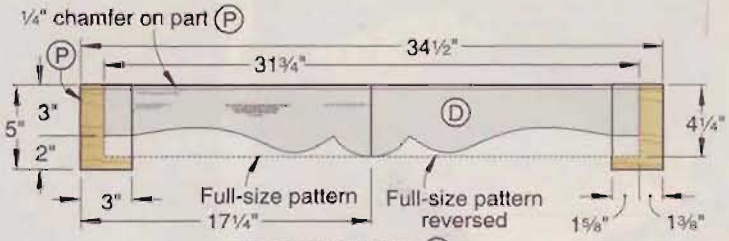


TOP FRONT RAIL (D) AND BASE FRONT TRIM (P)

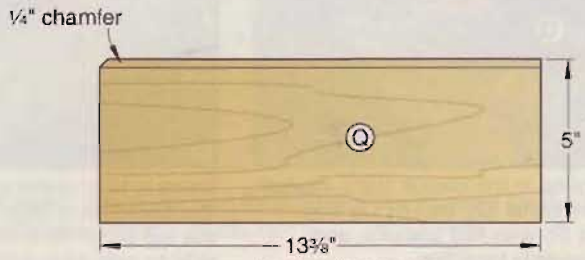


BASE SIDE TRIM

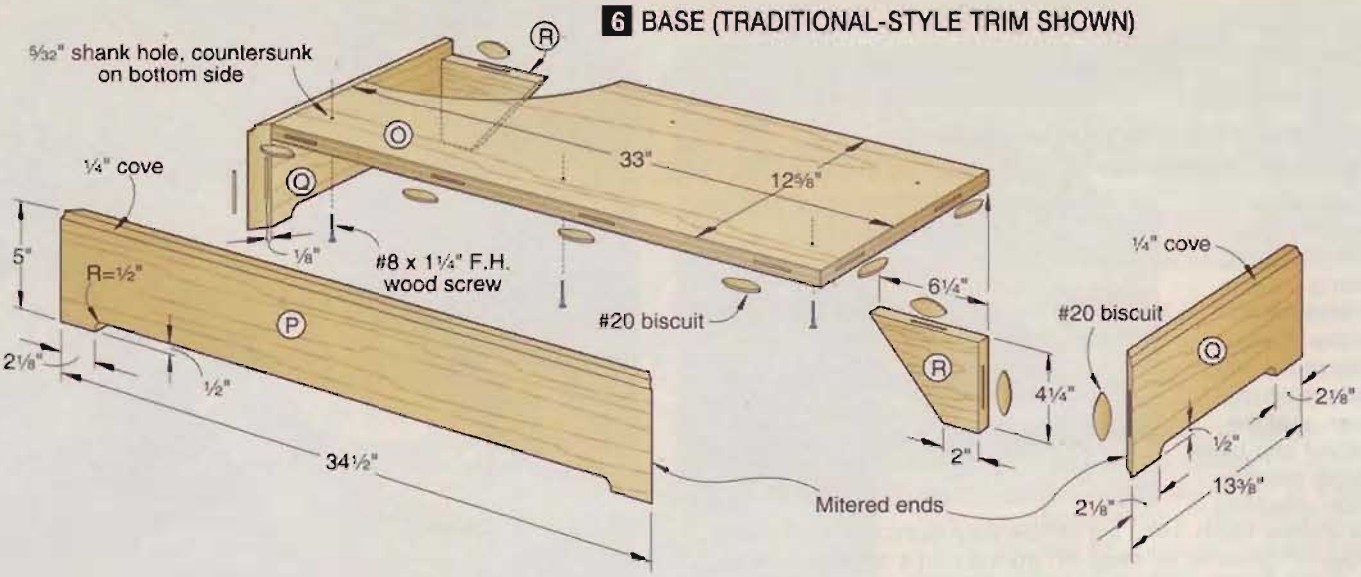
5 COUNTRY TOP FRONT RAIL AND BASE TRIM



TOP FRONT RAIL (D) AND BASE FRONT TRIM (P)



BASE SIDE TRIM



3 Lay out the applicable contour on the trim. **For a shaker bookcase**, lay out the curve on the front and side trim (P, Q), where dimensioned on **Drawing 4**. **For a country bookcase**, adhere the remaining two copies of the base front trim pattern to the front trim (P), as you did for the top front rail (D), where shown on **Drawing 5**. [The country base's side trim (Q) does not have a contour.] **For a traditional base**, lay out the contour on the front and side trim (P, Q), where dimensioned on **Drawing 6**.

4 Bandsaw the trim to shape, cutting just outside the lines, and then sand to the lines.

5 Cut the corner blocks (R) to size, angle-cutting one end, where dimensioned on **Drawing 6**.

6 Mark centerlines for #20 biscuits on the bottom panel (O), trim (P, Q), and corner blocks (R), where shown on **Drawing 6**. Then, position your biscuit-joiner fence to center the slot cutter on the thickness of the bottom panel. Plunge all of the slots except the ones in the trim's mitered ends. For these, reposition the fence to offset the slot ⅛" from the trim's inside face to ensure the slot cutter does not go through the outside face. Now, plunge the slots in the mitered ends.

7 Assemble the bottom panel, trim, and corner blocks, as shown in **Photo C**. When the glue dries, sand the assembly smooth.

8 Using a helper, set the bookcase on its back on your workbench. Then, position and clamp the base assembly (O/P/Q/R) tight against the bookcase's bottom, flush with the back and centered side to side. Drill countersunk mounting holes through the bottom panel (O) and ½" into the bottom (C), where shown on **Drawings 3** and **6**, and drive the screws. Now, with the instructions in one of the three following sections, add a traditional, Shaker, or country top to the bookcase.

Make a traditional top

1 Cut the plywood top panel (S) to size. Then, miter-cut the front and side edging (T, U) to length to fit the panel, where shown on **Drawing 7**. Now, glue and clamp the edging to the panel.

2 To form the top trim assembly, cut the band, cap, and cove blanks (V, W, X) to the listed sizes, except cut the cove blank (X) to a width of 1½". (The cove blank is initially extra wide for safety when routing.) Rout a ¼" chamfer along an edge of the cap blank (W) and a ½" cove along an edge of the cove blank (X), where shown. Now, rip the cove blank to a width of ⅝".

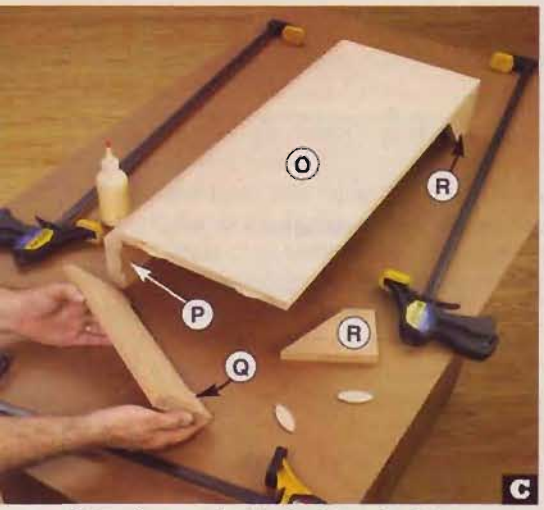
3 Glue and clamp the blanks together in the arrangement shown on **Drawings 7** and **7a**. When the glue dries, miter-cut the assembly so the back (short) edge measures 12¼" for the sides and 32¼" for the front.

4 Glue the front trim piece to the top panel (S), as shown in **Photo D**. Then, glue and clamp the side trim pieces in place.

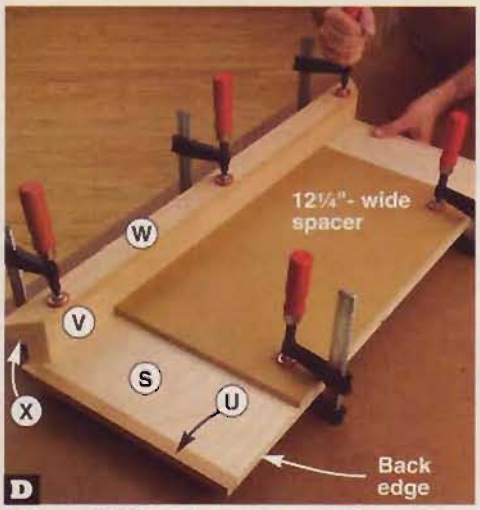
5 With the bookcase on its back, position and clamp the top panel/trim assembly (S through X) tight against the bookcase's top, flush with the back and centered side to side. Drill mounting holes through the top panel (S) and into the top (C), where shown on **Drawings 3** and **7**, and drive the screws.

6 To form the front and side dentil molding (Y, Z), shown on **Drawings 3** and **3a**, cut a ¾×54" workpiece from ¼"-thick oak. Mark the locations for ¼" dadoes spaced ¾" apart along the length of the workpiece, where dimensioned on **Drawing 8**. Now, using a dado blade, cut the dadoes ⅛" deep.

7 Cut the molding to the listed lengths, leaving ¼"-wide recesses at the ends of the front dentil molding (Y) and ⅛" wide recesses at the ends of the side dentil molding (Z), where shown. Now, glue the front molding to the top front rail (D) and the side molding to the top side rails (G), tight against the top-panel edging (T, U), where shown on **Drawing 3**.

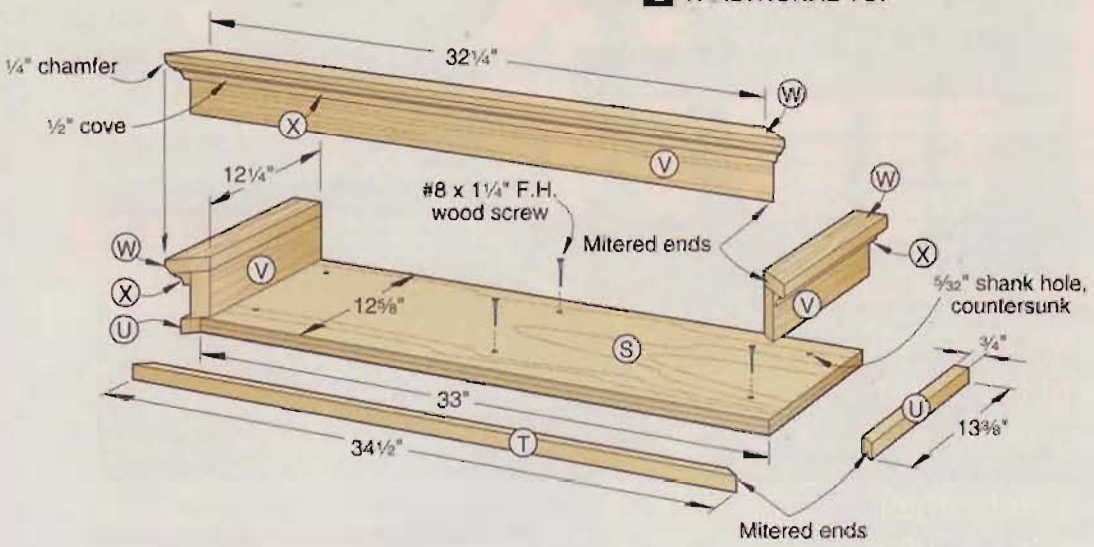


With glue applied in the biscuit slots, assemble the bottom panel (O), trim (P, Q), and corner blocks (R) with #20 biscuits, and clamp the assembly together.

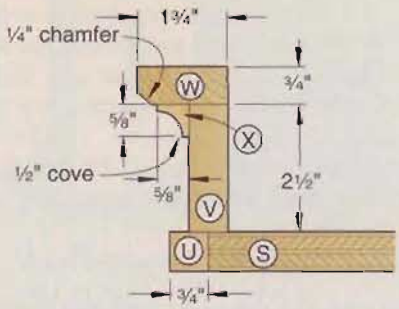


Using a 12¼"-wide scrap spacer to position the front trim (V/W/X) from the back edge of the top panel (S) and centering the assembly side to side, glue and clamp it to the panel.

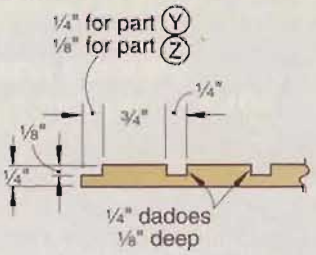
7 TRADITIONAL TOP



7a SIDE SECTION DETAIL



8 DENTIL MOLDING DETAIL



Build a Shaker top

1 Cut the plywood top panel (S) to size. Then, miter-cut the front and side edging (AA, BB) to length to fit the panel, where shown on **Drawing 9**. Now, glue and clamp the edging to the panel.

2 Tilt your tablesaw's blade to 17° from vertical. Now, using a tall auxiliary fence attached to your rip fence for support, bevel-rip the edging, where dimensioned on **Drawing 9a**, cutting the side edging first and then the front edging. Sand the bevels smooth.

3 With the bookcase on its back, position and clamp the top panel/trim assembly (S/AA/BB) tight against the bookcase's top, flush with the back and centered side to side. Drill mounting holes through the top panel (S) and into the top (C), where shown on **Drawings 3** and **9**, and drive the screws.

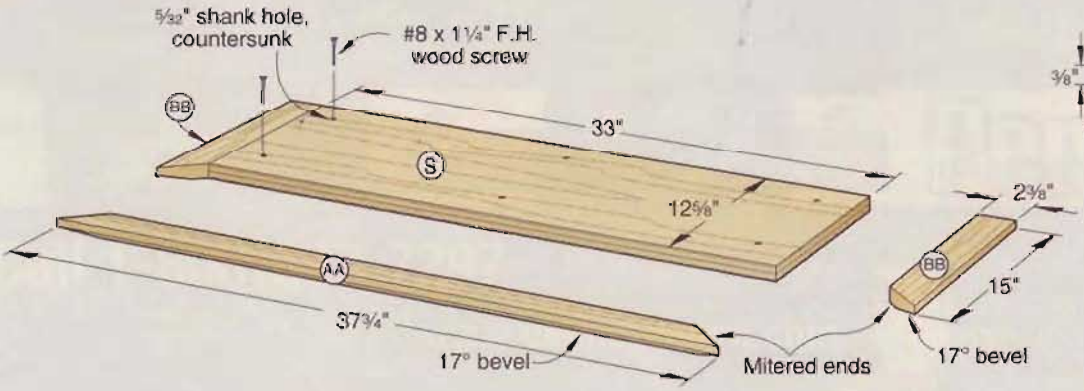
Add a country top

1 Cut the plywood top panel (S) to size. Then, miter-cut the front and side bands (CC, DD) to length to fit the panel, where shown on **Drawings 10** and **10a**. Now, glue and clamp the bands to the panel.

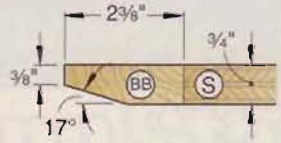
2 From ¾"-thick knotty pine, cut a 2½×72" workpiece to form the front and side caps (EE, FF). Then, rout a ¼" chamfer along an edge of the workpiece, where shown. Miter-cut the caps to length to fit on top of the bands (CC, DD). Now, glue and clamp the caps in place, keeping their back edge flush with the bands' back face.

3 Cut the front and side crown molding (GG, HH) to the lengths listed. (We used architectural pine wood molding no. WM54, available at home centers.) Then, glue the molding to the bands (CC, DD) and caps (EE, FF), where shown.

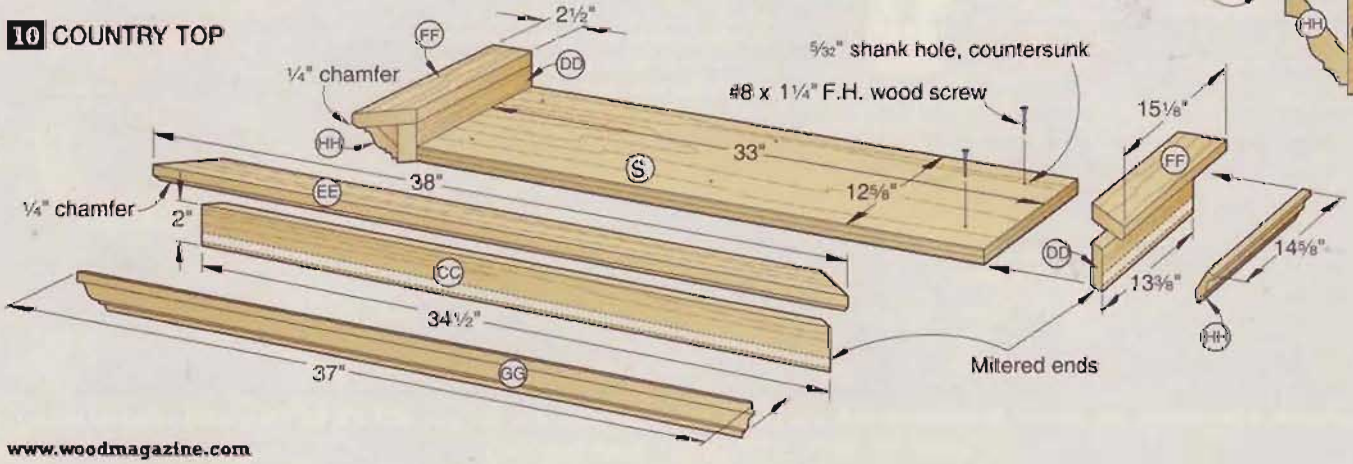
9 SHAKER TOP



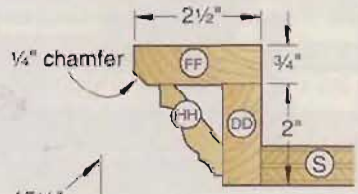
9a SIDE SECTION DETAIL



10 COUNTRY TOP



10a SIDE SECTION DETAIL



Finish up

1 Sand any areas that need it with 220-grit sandpaper, and remove the dust.

2 Finish the bookcase as you wish. **For the traditional bookcase**, we applied ZAR Oil-Based Stain no. 114 Provincial and two coats of AquaZAR Water-Based Clear Satin Polyurethane, sanding to 320 grit between coats.

For the Shaker bookcase, we omitted a stain and applied two coats of DEFT Satin Lacquer Clear Wood Finish, sanding to 320 grit between coats.

For the country bookcase, we first applied Minwax Pre-Stain Wood Conditioner to help the knotty pine absorb the stain evenly. (We kept the wood wet until it stopped soaking in the conditioner before wiping off the excess.) Then, we applied Minwax Oil-Based Wood Finish, no. 218 Puritan Pine. After the stain dried, we finished with two coats of Minwax Fast-Drying Polyurethane, sanding to 220 grit between coats.

3 Finally, install the sleeves (beveled end in first) for the paddle supports in all of the holes in the sides (A). Then, with your helper, place the bookcase where you wish, and install the paddle supports and shelves (M/N). Now, start filling this lofty library with your favorite books.

Written by **Owen Duvall** with **Chuck Hedlund**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine**

Materials List

	Case	FINISHED SIZE T	W	L	Matl.	Qty.
A	sides	¾"	11¾"	71½"	CP	2
B	front stiles	1½"	1¼"	71½"	CL	2
C	top, fixed shelf, and bottom	¾"	11¾"	31¾"	CP	3
D	top front rail	¾"	†	31¾"	CS	1
E	fixed-shelf front rail	¾"	2"	31¾"	CS	1
F	bottom front rail	¾"	¾"	31¾"	CS	1
G	top side rails	¼"	3"	10"	CS	2
H	middle and bottom side rails	¼"	4"	10"	CS	4
I	back stiles	½"	1½"	71½"	CS	2
J	back	¼"	32¾"	71½"	CP	1
K	upper fillers	¾"	¾"	††	CS	2
L	lower fillers	¾"	¾"	26"	CS	2
M	adjustable shelves	¾"	10¾"	31⅛"	CP	3
N	shelf trim	¾"	1¼"	31⅛"	CS	3
Base						
O	bottom panel	¾"	12⅝"	33"	BP	1
P*	front trim	¾"	5"	34½"	CS	1
Q*	side trim	¾"	5"	13⅜"	CS	2
R	corner blocks	¾"	4¼"	6¼"	CS	2
Traditional top						
S	top panel	¾"	12⅝"	33"	BP	1
T	front edging	¾"	¾"	34½"	O	1
U	side edging	¾"	¾"	13⅜"	O	2
V	band blank	¾"	2½"	72"	O	1
W	cap blank	¾"	1¾"	72"	O	1
X*	cove blank	⅝"	⅝"	72"	O	1
Y*	front dentil molding	¼"	¾"	31¼"	O	1
Z*	side dentil molding	¼"	¾"	10"	O	2
Shaker top						
S	top panel	¾"	12⅝"	33"	BP	1
AA	front edging	¾"	2⅜"	37¾"	C	1
BB	side edging	¾"	2⅜"	15"	C	2
Country top						
S	top panel	¾"	12⅝"	33"	BP	1
CC	front band	¾"	2"	34½"	KP	1
DD	side bands	¾"	2"	13⅜"	KP	2
EE*	front cap	¾"	2½"	38"	KP	1
FF*	side caps	¾"	2½"	15⅛"	KP	2
GG	front crown molding	9/16"	2¼"	37"	P	1
HH	side crown molding	9/16"	2¼"	14⅝"	P	2

*Parts initially cut oversize. See the instructions.

†**For traditional and Shaker bookcases**, width of part D is 3". **For country bookcase**, width of part D is 4¼".

††**For traditional and Shaker bookcases**, length of part K is 39¾". **For country bookcase**, length of part K is 38½".

Materials key: CP–choose plywood species, CL–choose laminated solid stock species, CS–choose solid stock species, BP–birch plywood, O–oak, C–cherry, KP–knotty pine, P–pine. For items CP, CL, and CS, use oak for the traditional bookcase, cherry for the Shaker bookcase, and knotty pine for the country bookcase.

Supplies: Spray adhesive; #6×¾", #8×1¼", and #8×1½" flathead wood screws; #20 biscuits.

Blades and bits: Dado-blade set, 19/64" brad-point drill bit. **For the country bookcase:** chamfer router bit. **For the Shaker bookcase:** ¼" round-over router bit. **For the traditional bookcase:** chamfer, ¼" and ½" cove router bits.

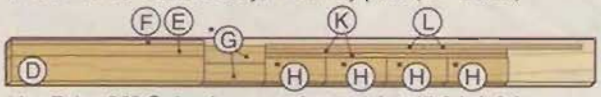
Sources

Hardware. Brass paddle supports, no. 63Z06.04, $4.50 for package of 20 (1 package); brass sleeves, no. 63Z06.06, $2.60 for package of 20 (5 packages). Call Lee Valley 800/871-8158, or go to www.leevalley.com.

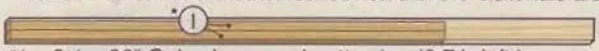
Drill bit. 19/64" brad-point drill bit, no. 07J02.19, $5.60. Lee Valley—phone and Web address above.

Cutting Diagram

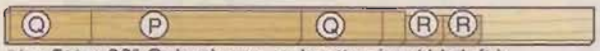
¾ x 7¼ x 96" Oak, cherry, or knotty pine (5.3 bd. ft.)



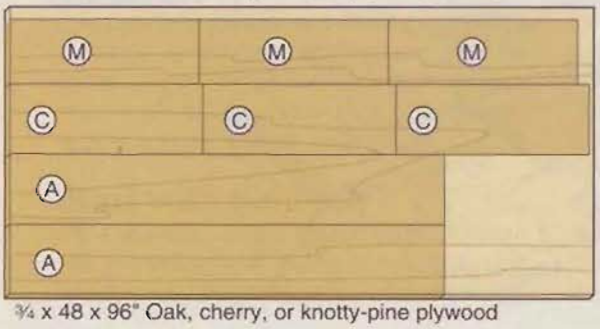
¾ x 7¼ x 96" Oak, cherry, or knotty pine (5.3 bd. ft.)
*Plane or resaw to the thicknesses listed in the Materials List.



¾ x 3½ x 96" Oak, cherry, or knotty pine (2.7 bd. ft.)

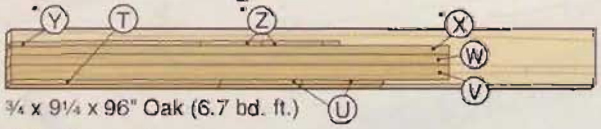


¾ x 5½ x 96" Oak, cherry, or knotty pine (4 bd. ft.)



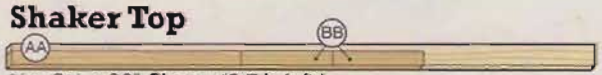
¾ x 48 x 96" Oak, cherry, or knotty-pine plywood

Traditional Top



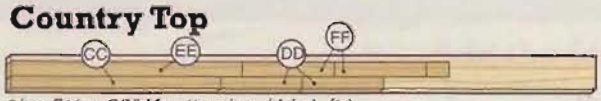
¾ x 9¼ x 96" Oak (6.7 bd. ft.)

Shaker Top

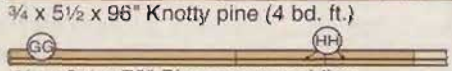


¾ x 3½ x 96" Cherry (2.7 bd. ft.)

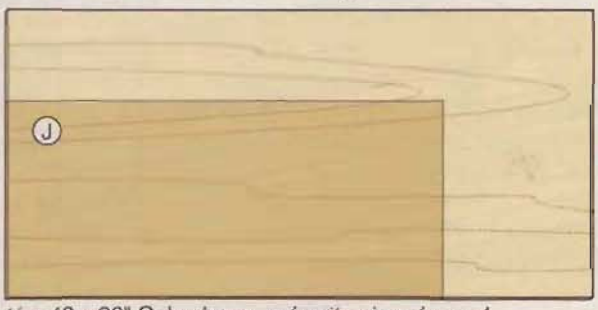
Country Top



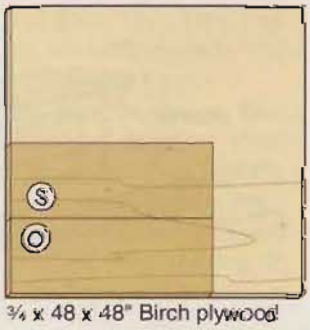
¾ x 5½ x 96" Knotty pine (4 bd. ft.)



9/16 x 2¼ x 72" Pine crown molding



¼ x 48 x 96" Oak, cherry, or knotty-pine plywood



¾ x 48 x 48" Birch plywood

shelf-top weather station

It gives quick readings of pressure, humidity, and temperature.

Expect a storm of compliments with this great little project. It's so good looking that no one will realize you made it from scraps that were gathering dust in your shop just yesterday.

For general guidelines on using barometer readings to predict the weather, see the sidebar, *opposite*. For handy reference, you may want to photocopy the sidebar and adhere it to the back of your weather station.

Start with the body

1 Laminate a blank for the body (A) from two ¾×4¼×12" pieces of oak. Plane the blank to 1⅜" thick, taking equal amounts off both faces. Joint one edge, and cut the blank to a finished size of 4×10", where dimensioned on the drawing, *opposite*.

2 Mark the vertical centerline on the body's front face and the 3½° tapers on its ends, where shown. Mark the ends and center of the body's bottom arch, bend a fairing stick to connect the three points, and draw the curve. Cut the tapers on your tablesaw and the arch on your bandsaw. Sand them smooth.

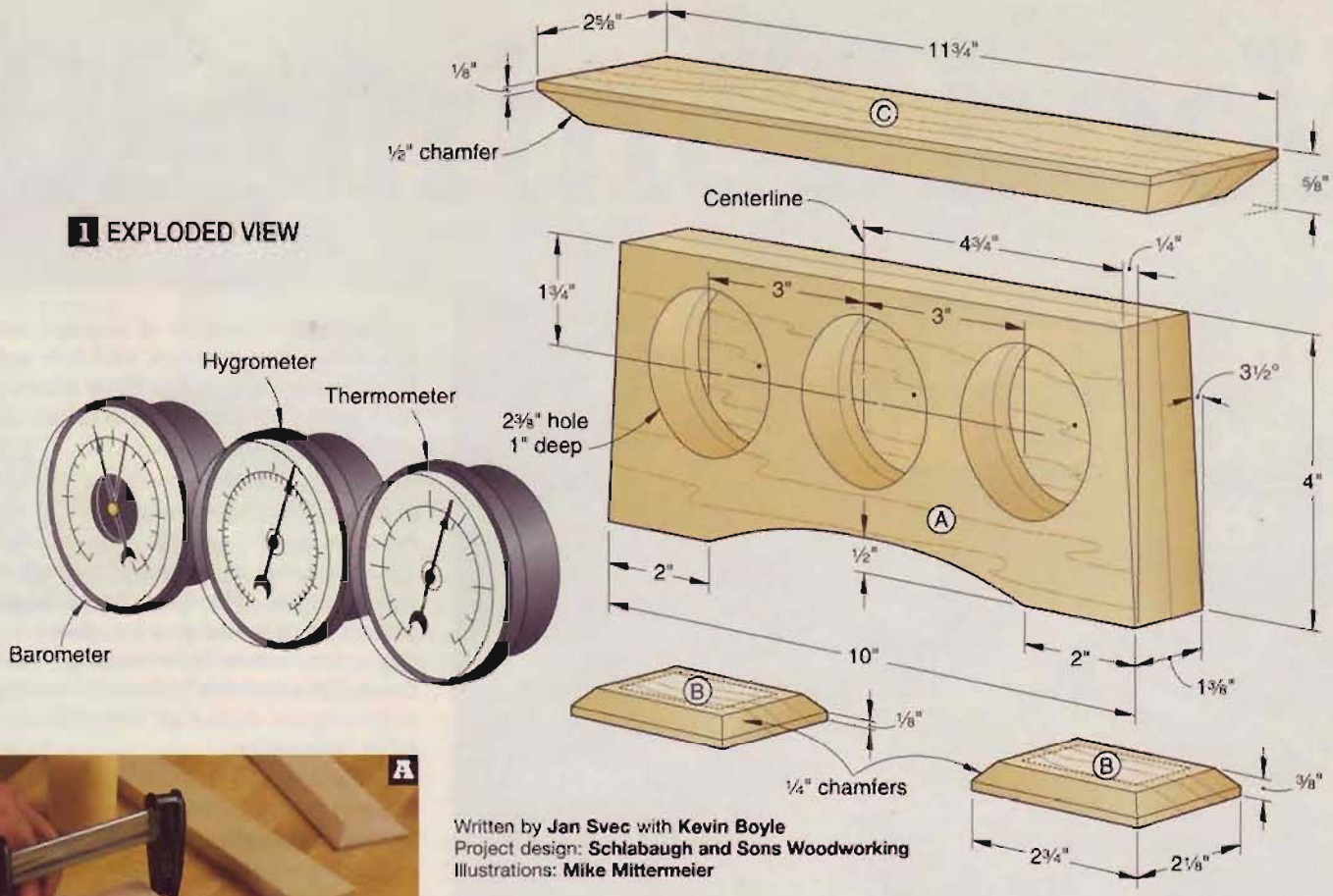
3 Working from the centerline, mark the centers of the three 2⅜" holes. Chuck a 2⅜" Forstner bit in your drill press, and drill the 1"-deep holes. Finish-sand the body.

Add the feet and top

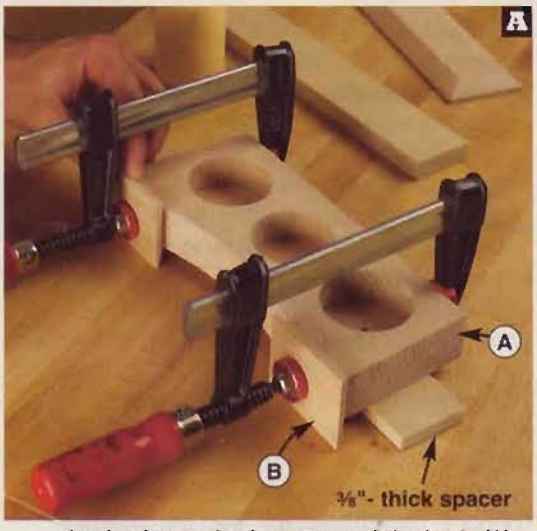
1 Plane oak stock to ⅜" thick, and cut two feet (B) to 2⅛×2¾". Then rout ¼" chamfers along their top ends and edges, where shown. Plane oak stock to ⅝" thick, and cut the top (C) to 2⅝×11¾". Then rout ½" chamfers along its bottom ends and edges. Finish-sand the feet and top.

2 To assemble the weather station, first cut two 2×14" spacers from ¾"-thick scrap stock. Plane one to ⅝" thick and the other to ⅜" thick. Using the spacers to position the body (A) for the proper front and back overhangs, glue the feet and top in place, as shown in **Photos A** and **B**.

1 EXPLODED VIEW



Written by **Jan Svec** with **Kevin Boyle**
Project design: **Schlabaugh and Sons Woodworking**
Illustrations: **Mike Mittermeier**



Apply glue to the foot areas of the body (A), and lay it on the ⅜"-thick spacer. Clamp the feet (B) in place, centering them side-to-side and front-to-back on the foot areas.

Apply the finish, and install the instruments

1 Inspect the assembly, and resand any areas that need it. Apply a stain and clear finish. (We applied Zar Dark Mahogany no. 118 stain, and then sprayed on two coats of Zar Aqua Coat satin finish, sanding with 220-grit sandpaper between coats.)

2 With the finish dry, set the barometer according to the instructions included with the instruments, and then press the instruments into the holes. Now check the temperature, humidity, and barometric pressure, and see if you can out-guess your local weatherman.

Sources

Instruments. Kit includes thermometer (1), hygrometer (1), and barometer (1). Order kit no. 200AC-WS-I, $29.95 ppd. Additional kits cost $24.95 each. Schlabaugh & Sons, 720 14th St. Kalona, IA 52247. Call 800/346-9663, or order online at www.schsons.com.

Forstner bit. 2⅜" Forstner bit no. 400901, $18.95 ppd. Schlabaugh & Sons, see *above*.

See more
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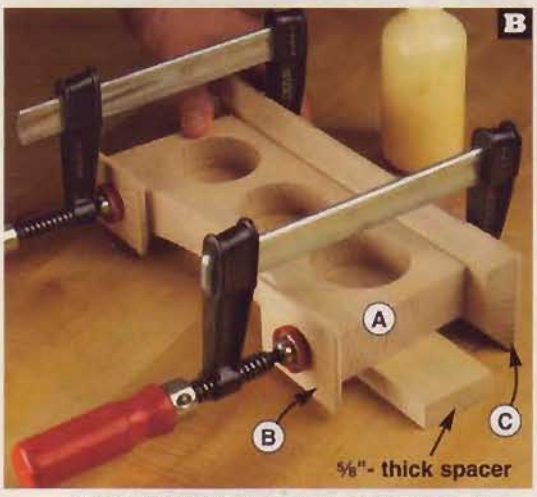


Apply glue to the top surface of the body (A), and lay it on the ⅝"-thick spacer. Clamp the top (C) in place, centering it side-to-side and front-to-back on the body.

HOW TO USE BAROMETER READINGS TO PREDICT THE WEATHER

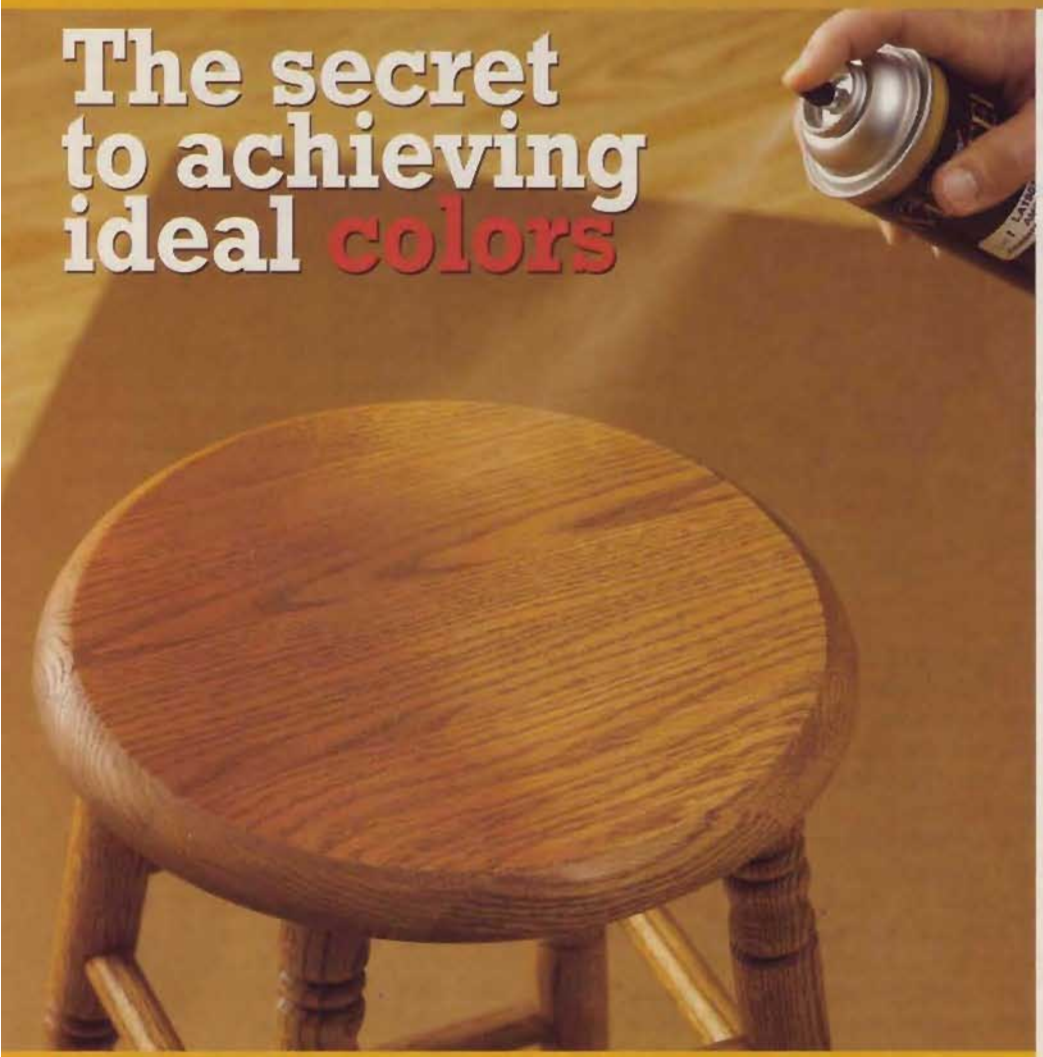
By combining wind direction with barometer readings, you can make some pretty good guesses about the type of weather headed your way. The National Weather Service provides the following rules of thumb for wind-barometer readings that are *generally* applicable to all parts of the United States:

Wind Direction	Barometer	Forecast
From S to SE	Falling steadily	Storm approaching from N or NW, passing near or to the north within 12 to 24 hours.*
From E to NE	Falling steadily	Storm approaching from S or SW, passing near or to the south within 12 to 24 hours.*
From E	Falling	Foul weather.
From W	Rising	Clearing and fair.

*The speed of the storm's approach and its intensity is indicated by the rate and amount of the fall in the barometric pressure.

Wood Toning 101

The secret to achieving ideal colors



Frustrated by different-colored boards of the same species? Wondering how to blend sapwood with heartwood, or match an old finish? Solving those problems is easier than you might think.

Sometimes stain doesn't give you the results you want. Maybe the project you just built and finished isn't quite the same color as the furniture that it's supposed to match, or an area of light sapwood stands out, or adjacent boards within the project vary too much in color. Fortunately, there's a straightforward solution to many such color problems: It's called toner.

A toner is simply a clear finish with dye or pigment added. Most often, the finish is lacquer, but it also can be shellac, water-base, or varnish. Those components are typically combined in an aerosol can that enables you to fine-tune your project's color like a professional.

Toner offers a couple of important advantages over stains: (1) It's easier to control the color you apply and (2) a toner goes on in a consistent layer on a sealed surface rather than soaking unevenly into the wood, adding another degree of control.

Buy it or mix it: Here's what's available

We bought lacquer-based toner in spray cans to prepare the samples you see in this article. We chose 13-ounce cans from www.woodfinisherssupply.com for $4.25 apiece. Klingspor's Woodworking Shop also carries toner in spray cans. Call 800/228-0000 to purchase a catalog.

Spray cans save a lot of time for professional furniture restorers, and they're fine for hobbyists, too. A few basic colors produce many hues when used in combination.

You also have the option of mixing your own toners. Do this by adding oil-soluble dye to lacquer; water-soluble dye to water-base; or alcohol-soluble dye to shellac. These, too, can be purchased through catalogs or online. The dyes can be liquid or powder. If you use powder, dissolve and strain the mixture before adding it to the finish. Woodworker's Supply carries a wide range of dyes. Call 800/645-9292 for more information.

In a pinch, you might choose to make a pigment toner by adding a small amount of artist's oil—available at stores that carry craft or art supplies—or lacquer-based pigment stain to lacquer; or add water-based pigment stain to water-base. However, a pigment toner obscures the grain of the wood if you apply it too heavily. We recommend sticking with dye toners.

When you mix a toner, start with a very small amount of colorant. Test the result, and add more as needed.

Once you find the right color, apply your homemade toner by spraying. You can't get the desired results by brushing or wiping. If you don't have high-volume, low-pressure (HVLP) equipment, try the inexpensive system shown at the *bottom of page 69*. It works well for small applications.

Take a subtle approach

No matter what task you tackle with toners, the basic usage rules remain the same:

- **Light it up.** Work in a well-lit area so you get a clear look at the colors. Also take the type of lighting into account. For example, a given color might look quite different in sunlight than under fluorescent lights.
- **Use thin coats.** Hold your spray applicator 12" to 15" away from the surface, and apply the toner as a light mist. Be sure to move the applicator quickly and steadily when spraying.
- **Take your time.** Pause often to let the toner dry, and look at the result from several angles to judge the result.

One caution: A toner that's incompatible with the underlying finish can result in cracks or crazing. If you have any doubts, apply a barrier coat of shellac before toning.

Learn to judge color

The biggest challenge in toning, of course, is to arrive at the right color. Practice will help you develop your eye, but don't worry: Most woodworking projects stick close to the basic earth tones. When in doubt, start with a light color, and gradually move toward a darker one if needed. It's easy to darken a finish, but almost impossible to lighten it without sanding or stripping it away and starting over.

Furthermore, it's easy to preview the effect of a toner before spraying it on your project. As shown in the photo at *right*, sample slides are available that let you see how various toners would alter the color. This allows you to buy exactly what you need for a project. However, you can test a shop-made toner with nothing more than a small pane of glass. It's a simple technique that we'll use as we set out to match an unfinished item to a finished one.

Some companies offer opaque color chips, but these see-through samples from Wood Finisher's Supply give you a truer preview. The complete deck of samples is item TU100, and costs $19.95.

Three ways toner can improve your projects

1 Change overall color

BEFORE

Toners reign supreme when you want to match pieces, such as these stools. If you don't have a stain of the exact color needed, find one that provides the right base color, and then turn to toners.

THE SOLUTION—STEP ONE

Test several basic earth tone stains on scrap that resembles the piece you plan to stain. Look for yellow or red tones in the stained piece to guide you. With practice, you'll learn to pick out the right background color.

STEP TWO

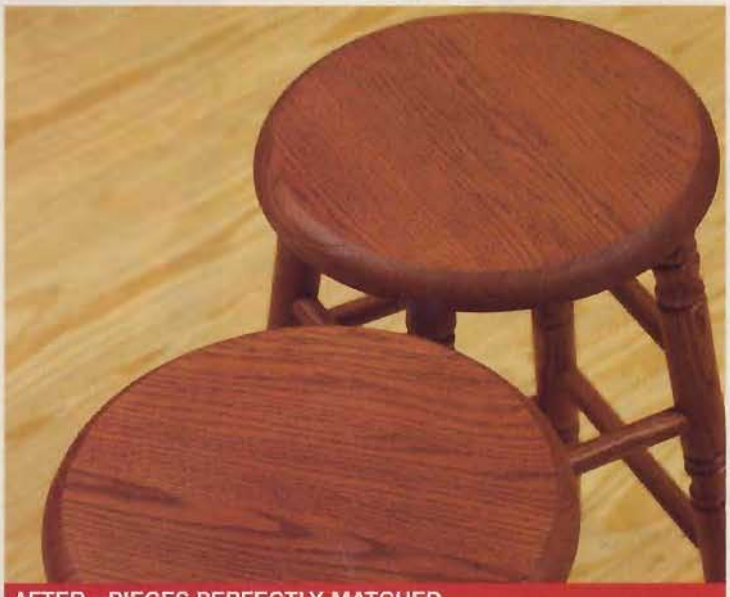
To test shop-made toner, spray it on glass, and then place the glass on the surface to be toned. Note: Here's your starting point when you simply want to adjust the color of a piece without regard to matching.

Toner gives you a quick way to tweak the color of a finished project until it suits you perfectly. Or, when you want to match a new project to existing pieces, toning can save the day.

As you see in the photo *above left*, we needed to match a finished stool that's made of red oak and has a reddish tone. First, as shown in the photo *above center*, we tested some common oil-based stains on red oak scrap. We chose the one that seemed to best match the background color of our finished stool, and then applied it to the unfinished piece. After the stain dried, we sealed the surface with shellac sprayed from an aerosol can. This step ensured that the toner would go on as a separate, transparent layer rather than being absorbed into the stain and wood. This helps keep the process simple and manageable.

Next, we sprayed several shades of toner on glass, laying down a light mist of one toner per pane. Then, we placed one pane at a time on the newly stained surface. When we tried the amber sample, shown in the photo *above right*, we saw the color we wanted. Of course, you might need more than one toner color to reach your goal.

The photo at *right* shows the next step. We simply sprayed toner on the stool in very light coats until the two pieces of furniture matched, as shown. After toning, spray on a clear topcoat for protection against wear.



AFTER—PIECES PERFECTLY MATCHED

Apply light mist coats of your chosen toner, as shown in the photo on *page 66*. Let each coat dry, and check the results from different angles. Eventually, you'll come up with a perfect match like this one.

2 Blend mismatches

BEFORE

Stain often fails to even out the differences between boards of different color, and can even emphasize them. The same thing happens if you opt for only a clear topcoat. Again, spray samples on glass to decide which toner or toners will do the trick.

THE SOLUTION

Seal a stained surface with a clear finish, and then mask off the areas that don't need color, either with tape or by holding a piece of cardboard where needed. Check your progress frequently by moving the cardboard or lifting the tape.

After you stain or topcoat a project, it's disappointing to see significant variations in color. Sometimes, boards just don't match, or an area of sapwood stands out like a beacon. Solve either problem by using toner on light areas to blend them with darker ones. This process is often referred to as blending.

We made a small tabletop with cherry boards, placing a significant area of sapwood along one joint. These photos show the problem, and how we solved it. If you use this method on cherry, place the wood in direct sunlight for a couple of days to let it darken, and then match that color.

Remove the masking material before you're done toning. Feather the toner into the rest of the surface as you make your final passes, rather than building a distinct ridge of finish. When you're satisfied with the color, stop and let the toner dry. Then, you might choose to add a light coat of toner over the entire piece to make the overall appearance as uniform as possible.

In most cases, you'll want to spray on a clear topcoat after the toner dries. Spraying instead of brushing avoids disturbing the toner coat, which becomes a problem if you apply lacquer on top of lacquer toner, or shellac on top of shellac toner. A good topcoat allows you to rub the finish without going through the toner.

AFTER—SAPWOOD SUCCESSFULLY BLENDED

Two toner colors—honey maple followed by medium red mahogany—combined to give the sapwood streak a warm cherry hue in this panel. With the sapwood blended in, we sprayed a mist coat of honey maple over the entire tabletop to even out the overall appearance.

3 Shade for effect

BEFORE

This raised-panel red oak cabinet door has an ordinary appearance after a coat of stain. We decided to shade the beveled edges of the panel for the illusion of greater depth.

THE SOLUTION

As you're learning to shade, it's best to mask around the area you want to color. Choose a toner that complements the existing stain, but darkens it noticeably.

When you spray toner onto selected areas of a project to increase color variation, it's called shading. Create an antique look by adding dark color to spots that normally accumulate dirt and wax, or emphasize the difference between high and low spots. These three photos show how we emphasized depth on a raised-panel door.

Written by **Jim Pollock** with **Jim Kull**

AFTER—DECORATIVE DEPTH ADDED

Shading produced a distinct contrast between the toned and untoned surfaces. The raised panel now seems to stand out visually much more than it did before.

Try the do-it-yourself approach to spraying toner

Many home centers and hardware stores carry a handy, very affordable product that's well suited to toning. The Preval spray system, made by the Precision Valve Corporation, consists of a pressurized sprayer unit and a detachable glass jar. We bought the system for under $4 at a home center.

To use it, simply change from one jar to another to spray different toners, and replace the spray canister when it loses its pressure. Each canister will spray approximately 16 ounces of liquid. Make sure to clean the unit by spraying a small amount of the appropriate solvent after each use, or it will clog.

trivet pursuit

Behind the complex maze of intersecting grooves that make up these turned kitchen accessories lies a very simple idea.

The idea for this turned trivet was sparked by a tablesawn one given to a friend of mine. Square and dadoed halfway through its thickness from each side, it got me thinking how I could make something similar on my lathe. Playing with the design on and off for about a year and a half, I started with a square trivet dadoed from one side and turned from the other, then tried a square turned from both sides, followed by an oval design. Finally, a round woven rattan trivet belonging to my mother provided the inspiration that clinched the design.

My method incorporates a simple offset turning technique and uses only a parting tool. The key is an auxiliary faceplate that holds and indexes the trivet blanks. Once you make it, you'll tear through your shop scraps making trivets by the dozen.

Reuben Everett

Prepare the trivet blanks

1 To create trivet blanks, plane 6½"-wide stock to ¼" thick, and cut it into 6½" lengths. Glue and clamp together pairs of these squares with the grain of one piece perpendicular to the grain of the other. (We combined maple with cherry and ash with walnut. You also can use a single piece of ½"-thick stock or, if you're feeling adventurous, try ½"-thick solid-surface countertop material, such as Corian.)

2 To make a pattern for accurately trimming your trivet blanks to shape, cut a 6½" square of ¾"-thick medium-densi-

ty fiberboard (MDF). Mark the center of the square by drawing its diagonals, and then use a compass to draw a 6⅛"-diameter circle on the square. Bandsaw the circle to shape, staying about ⅛" outside the line.

3 Attach the pattern disc blank to your lathe's 3" faceplate using the diagonal lines to center it. Fasten the disc with panhead sheet-metal screws long enough to penetrate ½" into the disc. Mount the disc on your lathe, and using your parting tool, turn the disc to a 6" diameter, as shown in **Photo A**.

4 Remove the pattern disc with the faceplate attached from your lathe. Place it on your laminated trivet blanks, and trace 6"-diameter circles on them with a pencil. Bandsaw the blanks just outside the pencil line. Now chuck a flush-trim bit in your table-mounted router and trim them to finished size, as shown in **Photo B**. With all the trivet blanks trimmed, remove the faceplate from the pattern disc.

Make an auxiliary faceplate

1 From ¾" MDF, cut a 10×10" backer, a 6½×10" insert, and two 1¾×10" guides. Glue and clamp the two guides to the backer; drill countersunk screw holes for #8×1¼" flathead wood screws, where shown on **Drawing 1**; and screw the guides to the backer, as shown in **Photo C**.

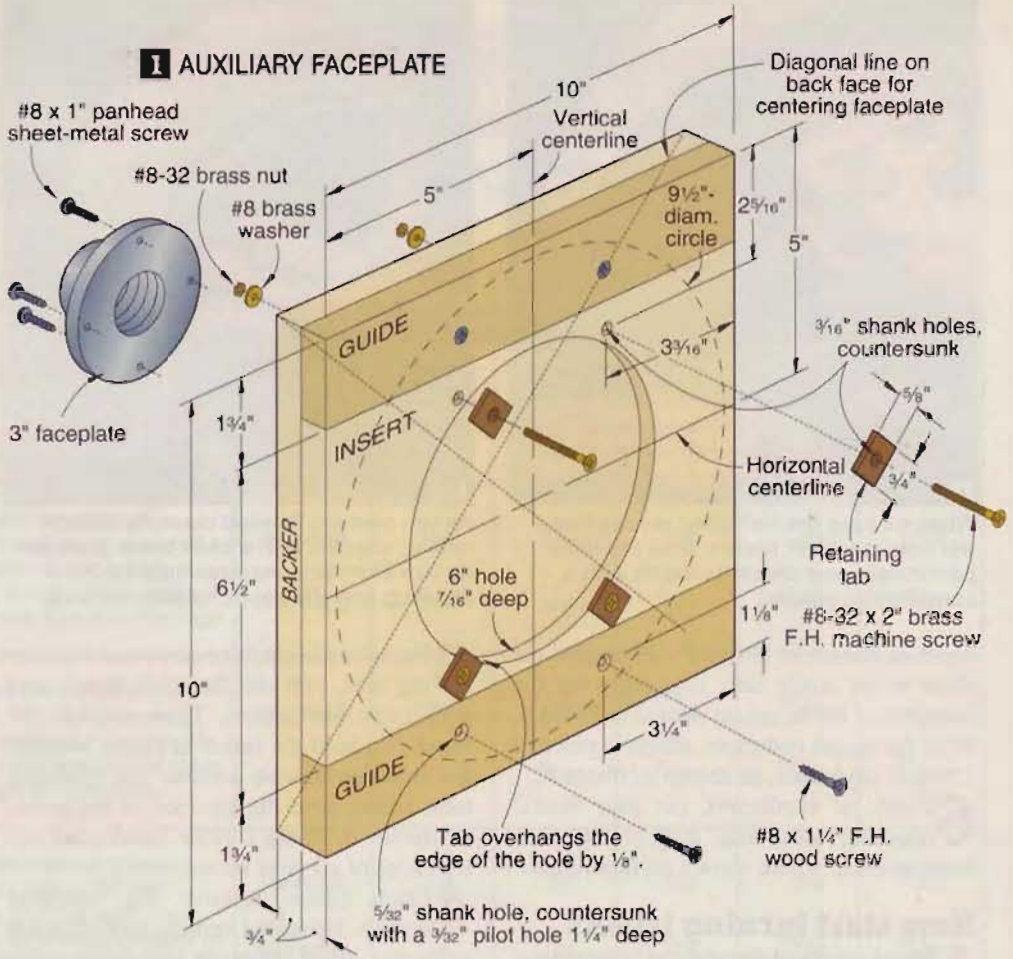
2 Drill countersunk holes for #8-32×2" brass flathead machine screws, where shown on **Drawing 1**. Remove the insert and waxed paper, and clean up any excess glue. Now reinstall the insert, and fasten it to the backer with the machine screws, washers, and nuts.

3 Locate the centers on the front and back faces of the auxiliary faceplate by drawing their diagonals. Referring to **Drawing 1**, draw a 6"-diameter circle, a 9½"-diameter circle (indicated by the dashed line), and horizontal and vertical centerlines on the front face. (You'll form a recess for the trivet blanks inside the 6" circle, and use the centerlines to offset the insert and index the trivet blanks later.)

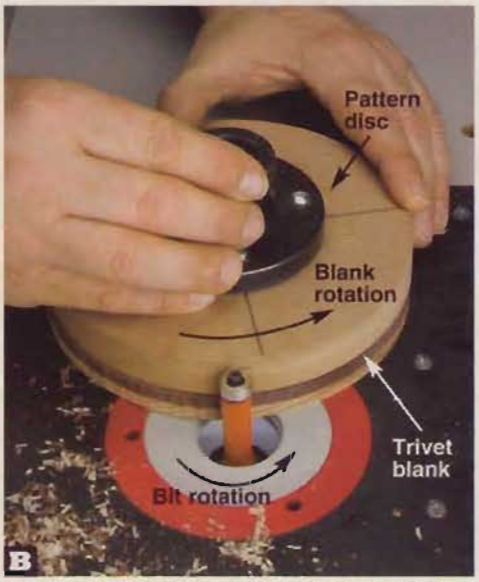
4 Bandsaw the auxiliary faceplate to shape, staying about ⅛" outside the 9½"-diameter circle. Using the drawn diagonals to center your lathe's 3" faceplate on the auxiliary faceplate back, drill pilot holes and screw it in place. Mount the assembly on your lathe, and use your parting tool to true its edge.

5 Working outward from the auxiliary faceplate center, start forming a 7/16"-deep recess with your parting tool. As you progress toward the marked circle, check its

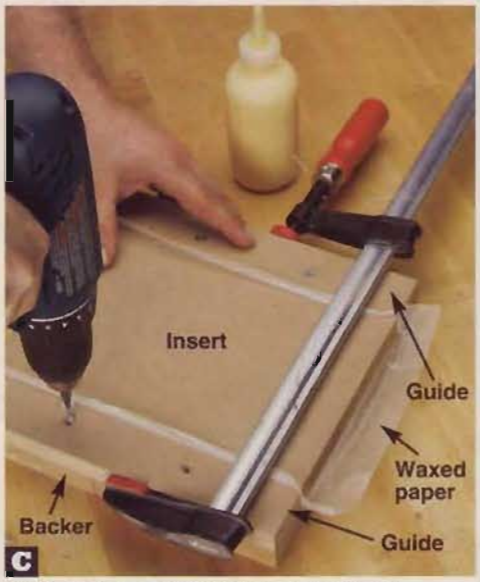
1 AUXILIARY FACEPLATE



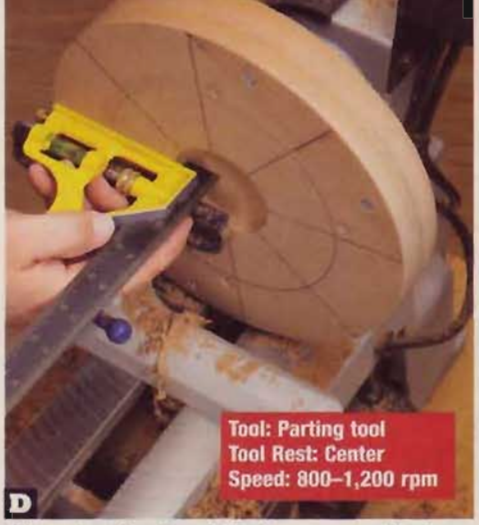
With the pattern disc blank mounted on your 3" faceplate, use your parting tool to true the disc and turn it to a 6" diameter. As you turn, check the diameter with calipers.



Secure the trivet blank to the pattern disc with double-faced tape. With a flush-trim bit in your table-mounted router, trim the blank to finished size.



With a piece of waxed paper wrapped around the insert for easy removal, apply glue to the guides, drill screw holes, and screw the guides to the backer.



When forming the 7/16"-deep recess that will hold the trivet blanks, stop the lathe periodically and check its depth with a combination square.

As you near the finished diameter of the recess, check it with a trivet blank. Increase its size in small increments until the blank fits snug and still allows for easy removal.

To keep the trivet blank from rotating in the recess during the turning operations, cut a piece of 120-grit sandpaper to size, spray it with adhesive, and stick it in the recess.

depth as shown in **Photo D**. When you get close to the circle line, start checking the diameter of the recess, as shown in **Photo E**. With the recess complete, adhere a piece of 120-grit sandpaper, as shown in **Photo F**.

6 From 1/8" hardboard, cut four 5/8×3/4" retaining tabs, and drill countersunk holes in each, where shown on **Drawing 1**.

Now start turning trivets

1 Make copies of the top and bottom trivet patterns from the *WOOD Patterns®* insert. Adhere the top patterns to the trivet blanks with spray adhesive. Then remove the machine screws from the auxiliary faceplate and mount a trivet blank, as shown in **Photo G**.

2 Start your lathe, and use your parting tool to cut the top face of the trivet, as shown in **Photo H**. Repeat these turning steps on all the trivet blanks.

3 Remove the machine screws and retaining tabs, pop out the trivet blank, and peel away the pattern. Then reinstall the blank. To hold the insert in place, reinstall the machine screws *without* the retaining tabs. Finish-sand the top face of the trivet, as shown in **Photo I**. Now finish-sand the top faces of all your trivets.

4 Once again, remove the machine screws. Using the vertical centerline for reference, offset the insert 1½" to the right, where shown on **Drawing 2**. Using the holes in the insert as guides, drill new 3/16" holes through the backer. Now trace the curved edge of the backer on the back of the insert. Remove the insert, and carefully bandsaw it on the traced line.

5 Place the insert in its new position, and fasten it with the retaining tabs, machine screws, washers, and nuts. Clamp the cutoff in the void created by offsetting the insert, where shown on **Drawing 2**. Drill countersunk screw holes and drive the screws.

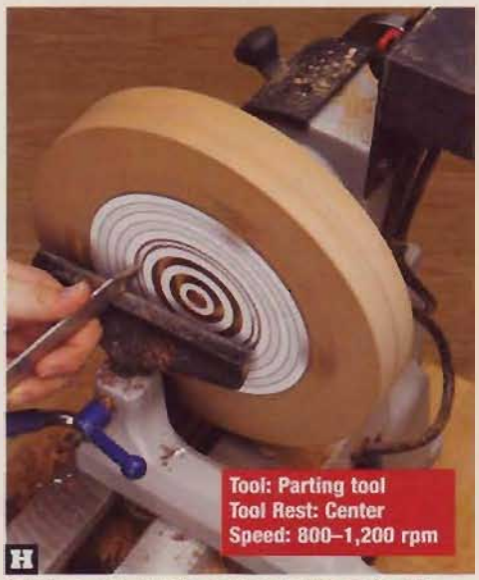
6 Adhere the bottom patterns to the trivet blanks with spray adhesive. Then mount a blank in the auxiliary faceplate recess, and align one of the pattern index lines with the faceplate horizontal centerline. Secure the blank with the retaining tabs.

7 Start your lathe, and use your parting tool to cut the first set of concentric grooves, as shown in **Photo J**.

8 With the first set of grooves cut, move on to the second set, as shown in **Photo K**, and turn these grooves, as shown in **Photo L**. In the same manner, turn the last set of grooves. Repeat these turning steps on all the trivet blanks.

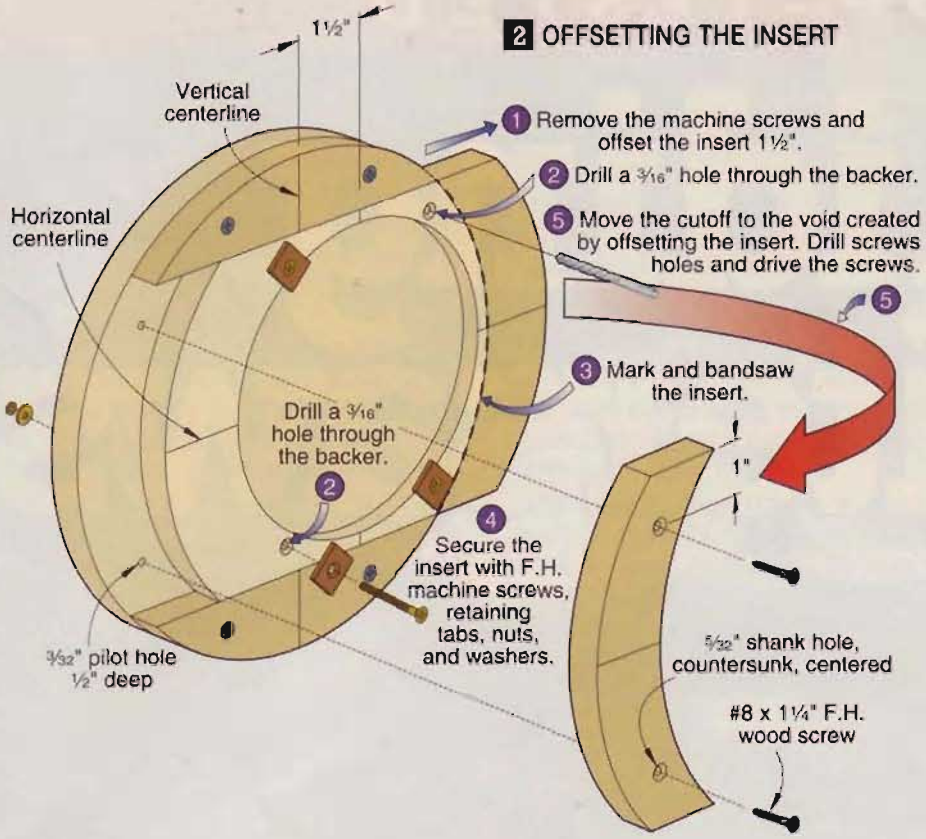
9 Remove the machine screws, retaining tabs, and the insert cutoff. Center the insert and secure it with the machine screws. Place the cutoff in its original

Position the trivet blank pattern side out in the auxiliary faceplate recess. Fasten it in place with the four retaining tabs and the flathead machine screws, washers, and nuts.



Cut into the blank, removing the pattern's shaded portions to a depth equal to half the trivet thickness. Stop just as you reach the different wood species of the bottom layer.

Holding the trivet in the auxiliary faceplate recess by pressing a piece of sandpaper against the trivet with your hand, switch on the lathe and finish-sand its top face.


2 OFFSETTING THE INSERT
1½"
Vertical centerline
Horizontal centerline
1 Remove the machine screws and offset the insert 1½".
2 Drill a 3/16" hole through the backer.
5 Move the cutoff to the void created by offsetting the insert. Drill screws holes and drive the screws.
3 Mark and bandsaw the insert.
Drill a 3/16" hole through the backer.
4 Secure the insert with F.H. machine screws, retaining tabs, nuts, and washers.
1"
3/32" pilot hole ½" deep
5/32" shank hole, countersunk, centered
#8 x 1¼" F.H. wood screw

position, drill pilot holes in the backer, and screw the cutoff in place. Remove the bottom patterns from the trivets and finish-sand the bottom faces as you did the tops. (The insert and its cutoff are now in position for a new batch of trivets.)

Finishing up

1 Use a hobby knife to trim away any flakes of wood left in the voids formed by the intersecting grooves.

2 Chuck a ⅛" round-over bit in your table-mounted router, and rout the top and bottom outside edges of the trivet. Finish-sand the round-overs.

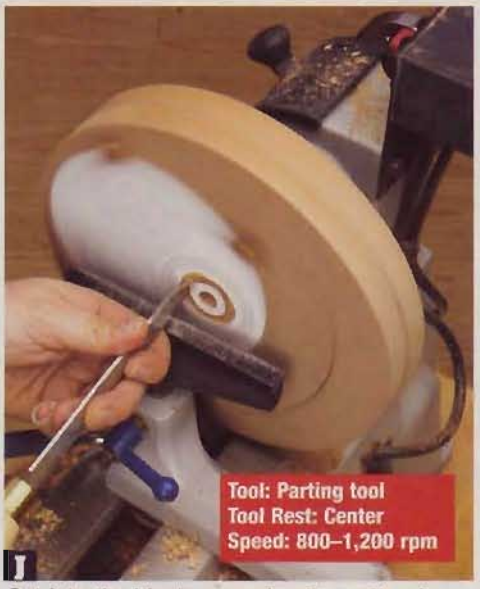
3 Apply three coats of penetrating-oil finish, following the directions on the container. Let the finish dry for several days. Now take a few trivets into the kitchen and start cooking.

Photo: Don Monteaux

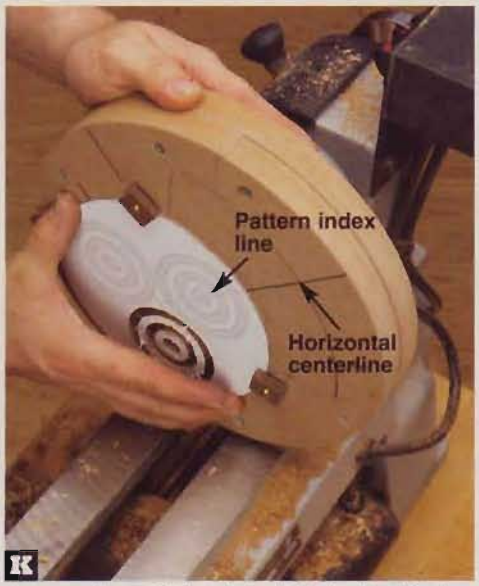
Reuben Everett

Retired after 33 years as a heating, air conditioning, and refrigeration service technician, Reuben now pursues his love of turning by making bowls, boxes, pens, and trivets that he sells through galleries. He also does architectural turning, producing balusters, newels, and column bases. Reuben taught turning at the Hermitage Foundation Museum in Norfolk, Virginia, and served as president of Tidewater Turners of Virginia. He was a demonstrator at the 2002 and 2003 symposiums of the American Association of Woodturners.

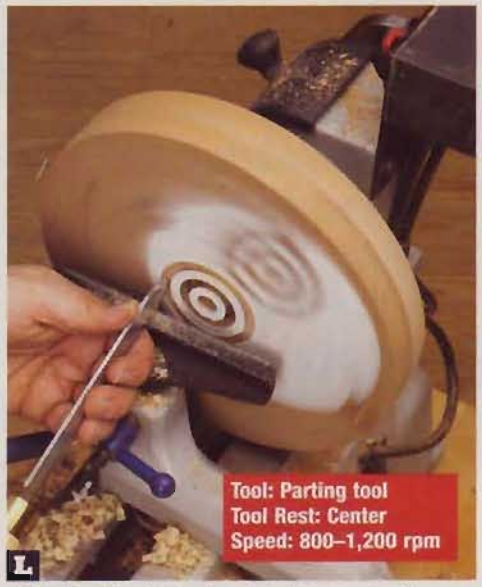
Written by **Jan Svec** with **Jeff Mertz**
Project design: **Reuben Everett, Virginia Beach, Va.**
Illustrations: **Roxanne LeMoine**



Cut into the blank, removing the pattern's shaded portions. To avoid catching the tool in the grooves cut from the other side, use a very light touch as you near the final depth.



Loosen the retaining tabs. Rotate the trivet blank 120°, aligning the pattern's next index line with the auxiliary faceplate horizontal centerline. Tighten the tabs.



With the trivet blank rotated to center the second set of concentric grooves, once again use your parting tool to remove the pattern's shaded portions.

10" sliding mitersaws

Take the accuracy of a compound mitersaw, expand its crosscut capacity, and you'll see the beauty of these seven sliders.

When it comes to crosscutting wood for projects, nothing beats a 10" sliding mitersaw, which can cut monster-size workpieces up to about 12" wide and 3½" thick. Sure, you can use a tablesaw, but for long workpieces, it's easier to move the saw through the wood than vice versa. And although radial-arm saws cut even wider than a slider, they have issues of their own, as you can see from the boxed information, *below*.

Six qualities that separate the sliding saws

1 Power and smooth cuts. We crosscut 2"-thick hard maple with all of the saws using their factory-supplied blades, and found that all had more than enough power for the task. After examining the freshly cut workpieces and noting any scoring or burning, we put identical new Freud sliding-mitersaw blades on each saw to level the playing field, repeated the cuts, and again noted the cut quality.

Regardless of the blade, all of the saws left burn-free and acceptably smooth cuts, but the surfaces left by the Bosch 4410, Hitachi C10FSH, and Makita LS1013 felt the smoothest. Only the Porter-Cable 3807 showed any improvement when we switched to the Freud, demonstrating that manufacturers now equip their saws with good quality blades, not "throwaways."

2 Accurate stops. Four of the saws—the Bosch 3915, Delta 36-240, Makita, and Porter-Cable arrived with their scales and stops dead-on accurate. We adjusted the others to perfection, then repeatedly slammed all of the saws, hard, through their full miter range to try to knock them out of alignment. The Bosch 3915, Hitachi, and Porter-Cable held their accuracy; the rest ended up ¼°–½° out of alignment at the 45° miter.

Miter stop detents should snap reliably into place every time. Ball detents on the Delta and Milwaukee 6497-6 are too soft for our liking, making it easy to blow past the stops. Makita's stops snapped into place, but fit sloppy enough that we could lock the angle as much as ½° off from the stop's stated angle. Both factors likely also contributed to these three saws' inaccuracy after the "slam" test.

The bevel- and miter-locking systems on these seven sliders proved easy enough to use and lock securely. Bosch engineers put the 4410's bevel lock right up front (see photo on the *next page*), so you don't have to fumble around behind the saw for a wing knob or lever when tilting the head. The

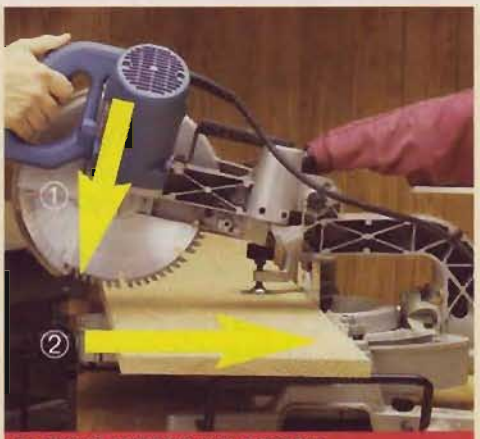
How sliding mitersaws compare to other crosscutting machines

A 10" sliding compound mitersaw (SCMS) represents the best combination of accuracy, capacity, safety, and price for the home woodworker. The chart *below* shows how five sizes and styles of crosscutting saws compare in key areas.

What we can't show in a chart, however, is how a sliding mitersaw is safer than a radial-arm saw (RAS). With an RAS, you pull the motor and blade in the same direction as the rotation of the blade (*near right* photo), which can cause the blade to lurch forward unexpectedly unless you carefully control the feed rate.

On an SCMS, you start with the blade above and on the outside edge of the workpiece (*far right* photo), plunge the blade, then push it through the workpiece. Although this bottom-up cutting action wants to lift the workpiece off the table, a properly used hold-down prevents that.

RADIAL-ARM SAW ACTION



SLIDING MITERSAW ACTION

You can't use a dado set on a sliding compound mitersaw, but that doesn't mean you can't make partial-depth cuts. All sliders have a depth-of-cut adjustment for just that purpose. Tenoning bed rails, and producing half-lap joints in outdoor structures are two examples of how you might use this feature in a woodworking shop.

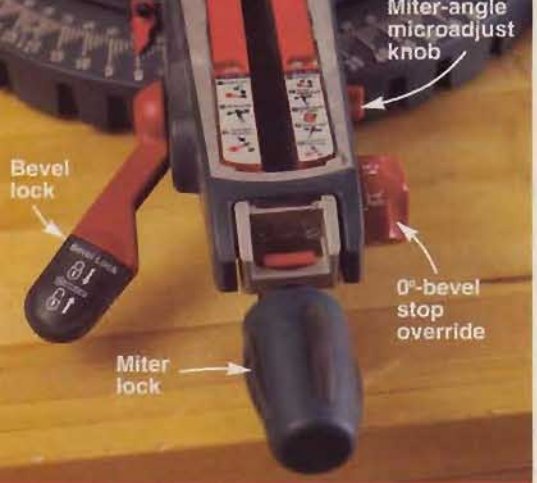
COMPARING THE CROSS-CUTTERS

	WORKPIECE CAPACITIES* (RANGE IN INCHES)	SPACE REQUIREMENT (DxW, INCHES)	PORTABLE?	RIPPING CAPABILITY?	DADO-SET CAPABILITY?	ACCURACY	COST
	10" Mitersaw: 5 - 5¾" wide; 3½" thick	24 x 20	Yes	No	No	A	$150-330
	12" Mitersaw: 7½ - 8" wide; 3½ - 4" thick	25 x 25	Yes	No	No	A	200-360
	10" Sliding mitersaw: 11½ - 12¾" wide; 3⅛ - 3⁹⁄₁₆" thick	30 x 30	Yes	No	No	B	390-580
	12" Sliding mitersaw: 12 - 12⅝" wide; 3½ - 4¾" thick	45 x 48	Yes	No	No	B	590-750
	10" Radial-arm saw: 13-16" wide; 2¾" thick	34 x 44	No	Yes	Yes	C	600-700

Width Thickness A Excellent B Good C Fair

*Ranges result from differences in capacity from model to model.

The accuracy grades on the chart are based on our experience with the various tools over the years. The more moving parts a tool has, the more opportunity for error and misalignment. Compound mitersaws tilt and rotate only; SCMSs tilt, rotate, and slide; RASs tilt, rotate, slide, and the head pivots on its carriage to turn it into a ripping machine.



BOSCH'S MISSION: CONTROL

You can lock the bevel angle, override the 0°-bevel stop to bevel to the right, and fine-tune the miter angle with conveniently located controls on the Bosch 4410.

4410, like the Hitachi and Makita models, bevels both left and right, making some operations, such as cutting crown molding that's lying flat, more intuitive. But we wouldn't list dual-beveling as a make-or-break feature unless you know you'll use it a lot.

3 Easy-to-read scales. We prefer scales with fine lines and widely spaced graduations that make it easy to accurately set angles to a fraction of a degree. Delta's miter scale has both attributes, but the cursor is located behind the fence on the left side of the saw, as shown *below*, so it's hard to read unless you're looking straight down on it. Miter scales on the Hitachi and Porter-Cable read easiest. As for bevel scales, we liked the Milwaukee 6497-6's best, owing to its widely-spaced markings and its location—up high, not tucked in low at the back of the saw.

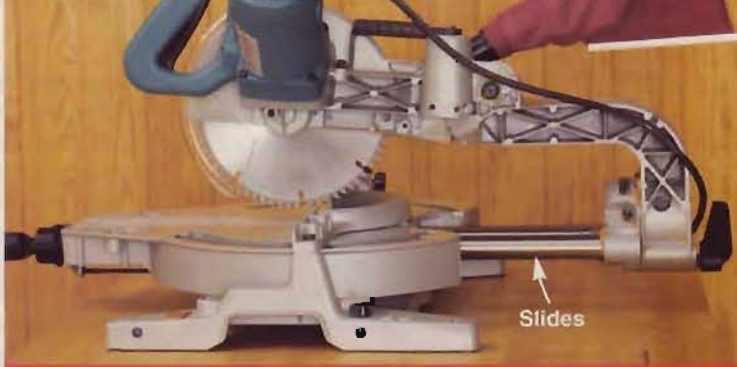
4 Effortless and precise cutting action. Here, we considered:

■ ***Plunge-and-slide action.*** It's smooth on most saws, but the Delta and Porter-Cable saws didn't slide as easily as the others; the Makita and Milwaukee saws plunged effortlessly and glided through the cut.

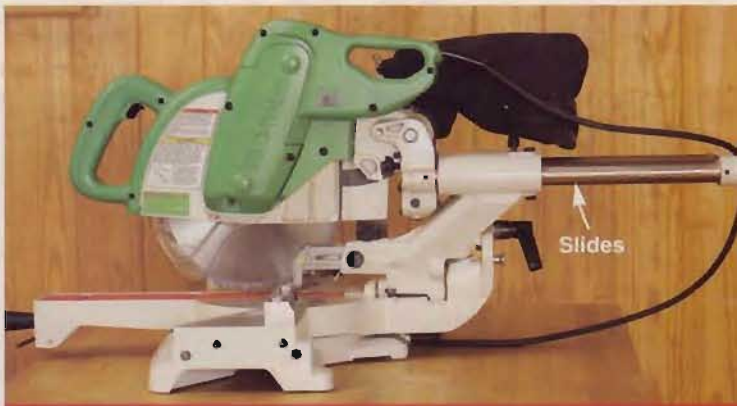
■ ***Head deflection.*** We tested the rigidity of the steel bar or bars on which the head slides by pulling the saw's cutting head all the way out to its full extension, and then applying 20 lbs. of sideways pressure. Using a dial indicator, we measured how much the arbor moved. The photos at *right* explain what happened.

■ ***Handles.*** We've never been fans of pistol-grip or vertical-D handles that put your wrist at an awkward angle at the start of each cut. We find the horizontal-D handles on the Delta and Porter-Cable models much more comfortable. If you can't make up your mind, the handle of the Bosch 4410 rotates and can be locked into any of four positions.

■ ***Power-up.*** Safety switches must be depressed on four saws before the motor will start; the Delta, Milwaukee, and Porter-Cable saws lack this device. Of those with safety switches, all can be operated either left- or right-handed, but Hitachi's switch felt uncomfortable to operate left-handed.



SLIDES BELOW THE TABLE DEFLECT LESS

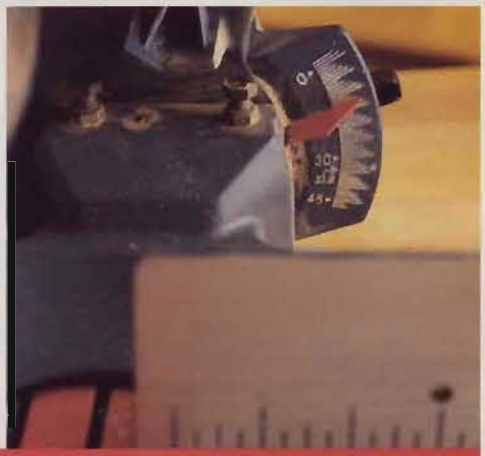


SLIDES ABOVE THE TABLE DEFLECT MORE

Delta, Makita (shown at *top*), and Porter-Cable all use a slide-under design, and their heads deflected an average of .023" at full extension. By comparison, over-the-table slides, such as those on the Hitachi (shown *above*) averaged .050" deflection—more than twice that of slide-under saws.

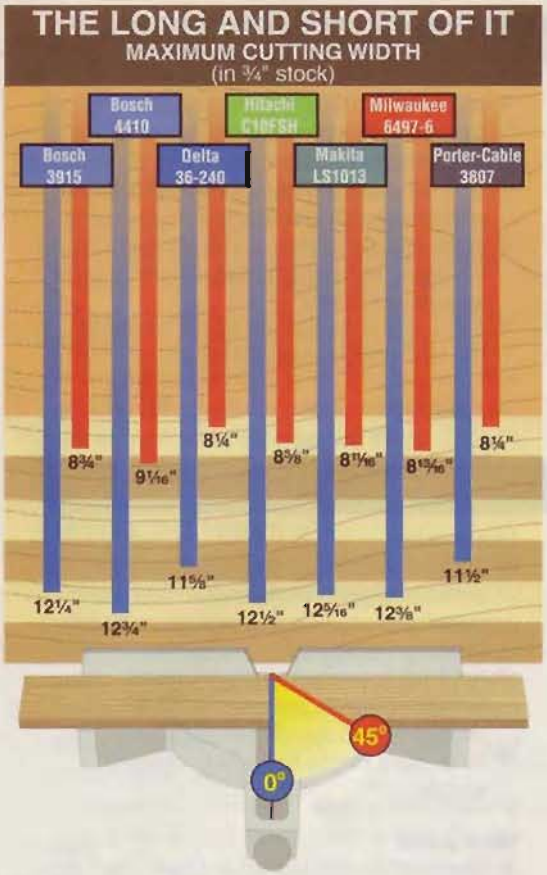
5 Ability to cut wide and deep. Let's face it: You buy a slider for the extra capacity it provides over a regular compound mitersaw. As you can see from The Long and Short Of It chart, *above right*, we found 1¼" difference between the largest and smallest capacities, from the Bosch 4410's max of 12¾" at 0° to Porter-Cable's 11½".

All of the saws can miter-cut angles larger than 45° in at least one direction (most can overcut both ways), and that's handy, for example, when cutting molding for an out-of-square corner. The Full Swing chart, *above far right*, shows the maximum miter angles each saw can cut. Angles above 50° were designed for homebuilders, who need the extra capacity for cutting rafters for steep-pitched roofs.



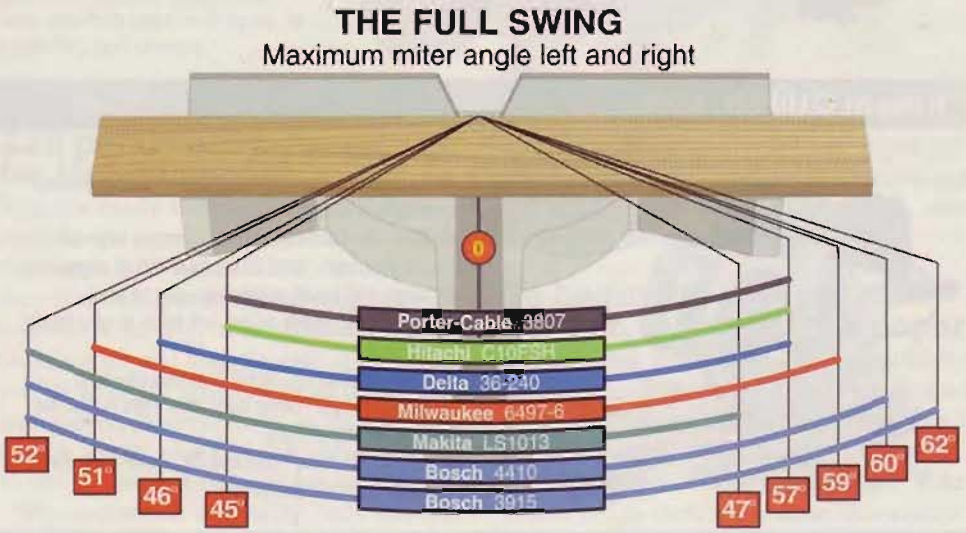
A TALE OF THREE SCALES

Besides clear markings, what makes a good miter or bevel scale? Location, location, location. We had to lean way over the Delta to read its miter scale (left) accurately. Milwaukee's bevel scale (center) reads easily from the normal operating position. The Bosch 3915's bevel scale at the rear of the saw (right), has stepped markings, some of which disappear behind the pointer.



6 A supportive fence. The ability to bevel and miter simultaneously allows the complex compound cuts required for cutting crown molding flat on the table. However, we find it more intuitive to cut crown in the position it will be in when fastened to the wall: angled between the fence and the saw table. (Learn more about cutting and installing crown molding in *WOOD*® magazine issue 135, *page 50*.) The fences on the Delta and Porter-Cable mitersaws aren't tall enough to support molding for such a cut without adding tall wooden auxiliary fence faces.

Fence support near the blade is essential when cutting thin stock on edge, but that need must be balanced with the ability of the blade to tilt for bevel cutting. The Bosch 4410, Hitachi, Makita, and Milwaukee all employ movable left fences that stay in close for 0°-bevel cuts, then flip or slide out of the way to accommodate the tilting head.



Now, a look at the seven sliders in our test

Bosch 3915, $390

877/267-2499, www.boschtools.com

High points

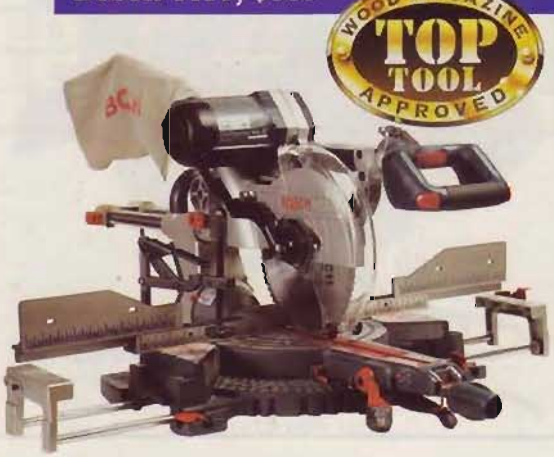
- This saw arrived perfectly aligned and held its cutting accuracy even when we purposely tried to knock it out of alignment.
- At 52° left and 62° right, its mitering range is the broadest in the test.
- 31.6° miter stop and 33.9° bevel stop for cutting crown molding.
- The lowest-priced saw in the test.

Low points

- The pointers of the miter and bevel scales hide some of the markings, which go from short to long every 5°. (See photo on the *previous page*.)
- Pistol-grip handle isn't as comfortable as horizontal-D style handle.

Bosch 4410, $560

877/267-2499, www.boschtools.com



High points

- Excellent cut quality even when using factory-supplied blade.
- Widest crosscutting capacity in the test: 12¾".
- Miter angles can be fine-tuned easily thanks to the built-in microadjustment system.
- Bevel lock is located up front, eliminating the need to reach behind the saw; wide, clear markings make the scale easy to read.
- 31.6° miter and 33.9° bevel stops for cutting crown molding flat on the table.
- Fence and table extend to 37"—the longest in the test—without the need for tools.
- Handle rotates to any of four positions to suit operator preference or angle of bevel cut.
- Quick-release depth-of-cut stop makes changing cutting depth fast.

Low points

- The pointer of the miter scale hides some of the markings.
- Knocking the saw around changed the miter accuracy by about ½°.
- It's the loudest saw in the test, the most expensive, and the heaviest by 10 lbs.
- The fence-adjustment bolts are seated deep in counterbores that make access difficult and provide little room for adjustment.

More points

- Dual-bevel saw tilts both left and right.

Delta 36-240 $420

800/438-2486, www.deltamachinery.com

High points

- Saw was perfectly aligned out of the box.
- Head deflection at full extension is among the lowest in the test.

Low points

- Soft detents and somewhat stiff table rotation make it hard to hit miter stops repeatably.
- Tied with Porter-Cable 3807 for the smallest crosscut capacity in test, at 11½".
- When used on the right side of the saw, the stock hold-down interferes with the table rotation and limits mitering capacity to 38°.
- The miter scale, located behind the left fence, is hard to read unless you look straight down on it.
- Its low fence is too short for cutting crown molding in "installation" orientation without use of an auxiliary subfence.
- A steel web in the dust port caused the port to clog with sawdust during normal use.

Hitachi C10FSH, $500

800/706-7337, www.hitachi.us/powertools

High points

- Excellent cut quality even when using factory-supplied blade.
- This saw held its cutting accuracy even when we purposely tried to knock it out of alignment.
- Miter and bevel scales are easy to read.
- Laser line shows where left edge of saw blade will cut.
- Two-position left fence provides up-close support for 0° bevel cuts, then flips out of the way for bevel-cuts.
- Has 31.6° miter stop and 34° bevel stop for cutting crown molding.

Low points

- Slotted mounting holes allow the fence to be shifted for alignment, but the slots in our saw weren't long enough, so we had to ream them to get enough adjustment.
- Pistol-grip handle isn't as comfortable as horizontal-D handle, and safety switch is uncomfortable to operate left-handed.
- No on-board storage for the blade-changing wrench.

More points

- Dual-bevel saw tilts both left and right.

HERE'S THE SCOOP ON SEVEN SLIDING MITERSAWS

			MOTOR	CAPACITY (INCHES)			FENCE			BEVELING		PERFORMANCE						
BRAND	MODEL	AMP DRAW	BLADE SPEED, NO LOAD (RPM)	MAXIMUM THICKNESS (0° BEVEL/45° BEVEL)	MAX. HEIGHT AT FENCE (WORKPIECE ON EDGE)	MAXIMUM LENGTH (INCHES)	MAXIMUM HEIGHT (INCHES)	MITER STOPS (DEGREES) (ALL SAWS HAVE STOPS AT 0°, 15°, 22.5°, AND 45° LEFT AND RIGHT.)	SINGLE OR DUAL BEVEL?	BEVEL STOPS (DEGREES) (ALL SAWS HAVE STOPS AT 0° AND 54°.)	CUT QUALITY (2)	MITER STOP RELIABILITY	MITER SCALE READABILITY	MITER LOCK, EASE OF USE	BEVEL STOP RELIABILITY	BEVEL SCALE READABILITY	BEVEL LOCK, EASE OF USE	HANDLE/POWER SWITCH COMFORT
BOSCH	3915	15	4,700	3½ / 2⁵⁄₁₆	3½	28	3½	31.6L, 31.6R, 60R	S	33.9L	B-	A	C	B	A	C	B	B
	4410	15	4,800	3⁷⁄₁₆ / 1¹⁵⁄₁₆	4	37	4	31.6L, 31.6R, 60R	D	33.9L, 33.9R	A	C	C	A	A	A-	A	A
DELTA	36-240	15	5,000	3⅛ / 2³⁄₁₆	3	27	1¾	31.6L, 31.6R	S		B	C-	D	C+	A	C	C	A-
HITACHI	C10FSH	12	3,800	3⁹⁄₁₆ / 2⅜	3½	27¼	3½	31.6L, 31.6R	D	30L, 34L	A	A	A	A	A	A	B	C
MAKITA	LS1013	13	3,700	3½ / 2¹⁄₁₆	3³⁄₁₆	22⅞	3³⁄₁₆	31.6L, 31.6R	D		A	D	C	A	C	B	C-	B
MILWAUKEE	6497-6	15	4,800	3⁷⁄₁₆ / 2¼	3⁹⁄₁₆	28¾	3⁹⁄₁₆	30L, 30R	S		B-	B-	A-	B+	B-	A	A-	B
PORTER-CABLE	3807	15	5,000	3⁵⁄₁₆ / 2¼	1¾	20⅞	1¾	31.6L, 31.6R	S		C	A	A	B-	A	C	C	A-

NOTES:

1. A Excellent; B Good; C Average; D Below average
2. Using new Freud LU91R0101 blades on all saws.
3. Measured at operator's position.
4. (C) Stock clamp; (CM) Crown-molding fence; (H) Horizontal stock clamp; (I) Throat insert plates; (R) Right-fence extension; (S) Length stop; (T) 90°/45° setup triangle; (X) Table extensions
5. (J) Japan; (T) Taiwan; (U) United States
6. Prices current at time of article's production and do not include shipping, where applicable.

Makita LS1013, $500

800/462-5482, www.makitatools.com

High points

- Excellent cut quality even when using factory-supplied blade.
- Smooth plunge-and-slide action, and little head deflection at full extension.
- Depth-of-cut stop flips out of the way for full-depth cuts and can be flipped back to repeat a partial-depth cut.
- Two-position left fence provides up-close support for 0° bevel cuts, then rotates out of the way for bevel-cuts.
- Up-front slide lock is easy to access.
- Noticeably the quietest saw in the test.

Low points

- Miter stops are sloppy and allowed us to lock in a miter angle as much as ½° from the stop angle.
- Pistol-grip handle isn't as comfortable as horizontal-D handle.

More points

- Miter scale is located on the right side of the turntable instead of up front. It's easy to read, but completely covered when a workpiece is on the saw.
- Dual-bevel saw tilts both left and right.

Milwaukee 6497-6, $450

800/729-3878, www.milwaukeetool.com

High points

- Smooth plunge-and-slide action.
- The best of the bevel scales, located on top of the saw in easy view of the operator, and with widely spaced markings.
- Two-position left fence provides up-close workpiece support. For bevel cuts, you remove the top portion of the fence with a quick-release lever, flip the fencetop, then remount it.

Low points

- Miter accuracy was off by ¼° after we knocked the saw around.
- Head deflection was high at full extension.
- Pistol-grip handle isn't as comfortable as horizontal-D handle.

More points

- Spring-loaded bevel stops can be bypassed by simply pushing the head harder, but they want to spring back when you loosen the lock to tweak an angle.

GRADES (1)						ACCESSORIES (4)				
EASE OF PLUNGE AND SLIDE	LACK OF SIDE-TO-SIDE HEAD DEFLECTION	DUST CONTROL EFFECTIVENESS	NOISE LEVEL (dB) (3)	CORD LENGTH (INCHES)	STANDARD	OPTIONAL	WARRANTY (YEARS)	COUNTRY OF ASSEMBLY (5)	WEIGHT (POUNDS)	SELLING PRICE (6)
B	B	B	104	94	C	I, S, X	1	T	55	$390
B	C	B	106	101	C, S, X	CM, I	1	T	65	560
C	A-	C-	101	98	C		2	T	52	420
B-	C	B	102	77	C	S, X	5	J	49	500
A	A	B	97	77	C, T, X	CM, H, R	1	U	47	500
A	C	B	101	57	C, S, X	I	5	T	55	450
C	A-	C-	104	108	C		1	T	53	450

Share your opinion of these saws in our Interactive Tool Review at **woodmagazine.com/SCMS**

Porter-Cable 3807, $450

800/487-8665, www.porter-cable.com

High points

- Was perfectly aligned out of the box and held its cutting accuracy even when we purposely tried to knock it out of alignment.
- Head deflection at full extension is among the lowest in the test.

Low points

- Tied with the Delta 36-240 for the smallest crosscut capacity in test at 11½".
- Low fence is too short for cutting crown molding in "installation" orientation without use of an auxiliary subfence.
- A steel web in the dust port caused the port to clog with sawdust during normal use.

Written by **Dave Campbell** with **Garry Smith**

The sliding mitersaws that tested best

Both the Bosch 4410 and the Hitachi C10FSH did well in our tests, but for different reasons. The nicely equipped 4410 offers the widest cutting capacity and a raft of features not found on any other saw in the test, such as extendable tables and fences, microadjustment for miter angles, and the up-front bevel lock. We were able to knock the 4410 out of alignment, but in a woodworking shop where it's not being thrown into the back of a truck and hauled from job site to job site, we're less concerned. We christened it the Top Tool for this test.

The Hitachi C10FSH lacks the bells and whistles of the 4410, but adds a laser for lining up your cuts. And, it sells for $60 less than the Bosch, so it's our Top Value.

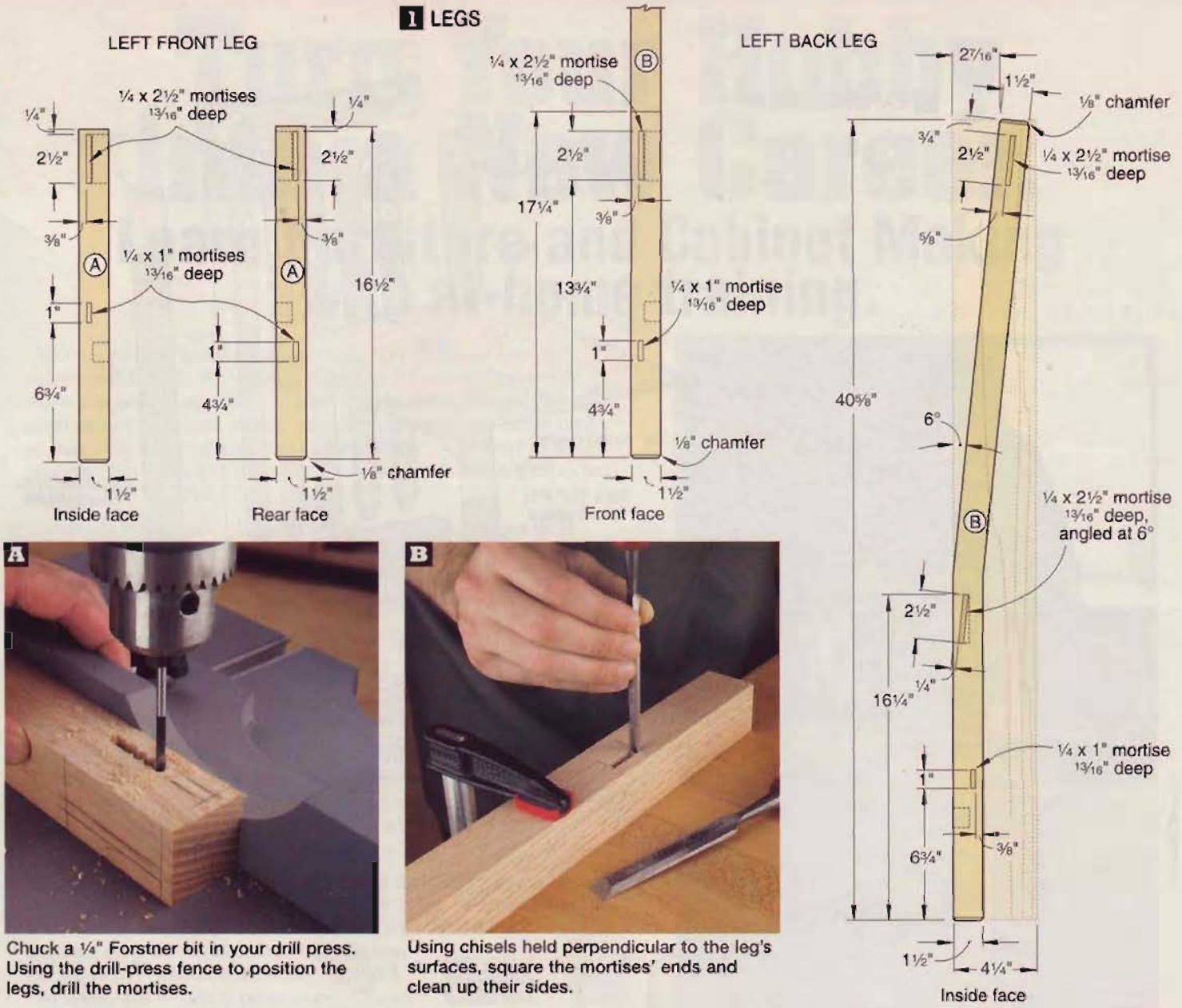
traditional oak

dining chair

If you've been anxiously awaiting the matching chair to the oak dining table featured in the November 2003 issue, relax—it's here. And, speaking of relaxing, you'll savor the comfort of this beauty's high, curved back and cushioned seat at mealtime. Whether you plan to build two chairs or a complete set of six, you'll also appreciate the straightforward construction and our simple money-saving method for upholstering the seats.

For the board feet of lumber and other items needed to build this project, see *page 85*.

Hungry for more dining room furniture? Then you'll want to start whetting your appetite for the May 2004 issue, where you'll find the plan for this sideboard. It matches the style of the oak chair and dining table.



Chuck a ¼" Forstner bit in your drill press. Using the drill-press fence to position the legs, drill the mortises.

Using chisels held perpendicular to the leg's surfaces, square the mortises' ends and clean up their sides.

Start with the legs

1 Plane 1¾"-thick stock to 1½" thick for the front legs (A) and back legs (B). Lay out the legs on the workpiece, where dimensioned on **Drawing 1**, nesting them where shown on the **Cutting Diagram** to reduce waste.

2 Cut the workpiece to form separate front and back leg blanks. Trim the front legs to the size listed in the **Materials List**. Then, bandsaw and sand the back legs to the layout lines. Crosscut the back legs' top ends perpendicular to their front faces.

3 Lay out the mortises on the front and back legs, where dimensioned, making sure you have mirrored pairs of legs. Drill the mortises, as shown in **Photo A**, and square them as shown in **Photo B**.

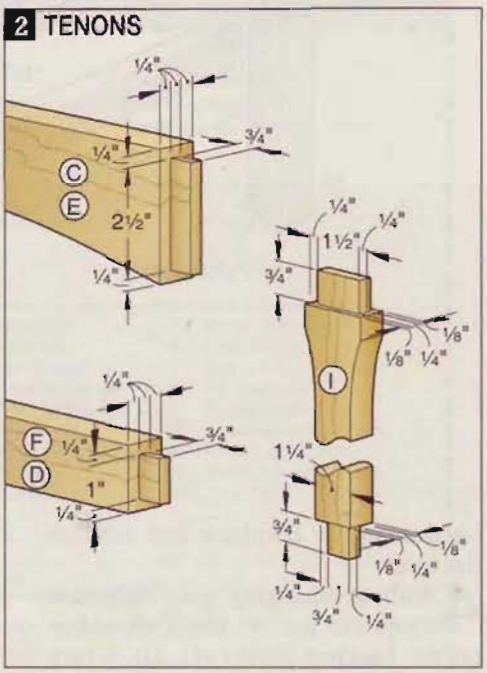
4 Sand ⅛" chamfers on the tops and bottoms of the back legs (B) and on the bottoms of the front legs (A), where shown.

Make the rails, stretchers, backrests, and slats

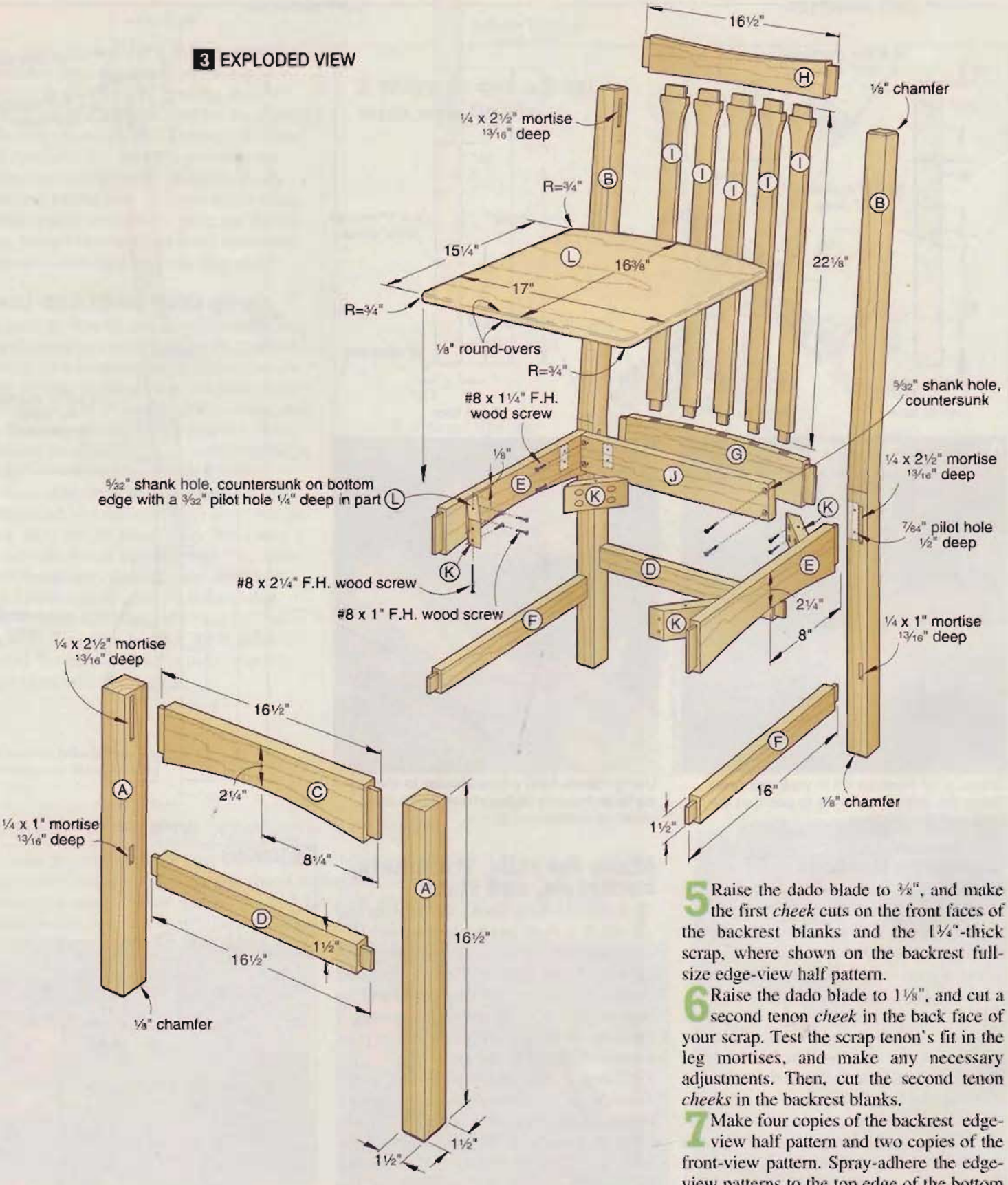
1 From ¾"-thick stock, cut the front seat rail (C), front and back stretchers (D), side seat rails (E), and side stretchers (F) to the sizes listed. From 1¾"-thick stock, cut two 3×16½" blanks for the bottom and top backrests (G, H). Set aside scrap pieces of the same thickness and width as the parts for testing your tenon cuts.

2 Using a dado blade and miter gauge with an auxiliary fence, cut sample tenons on the ¾"-thick scrap to the dimensions on **Drawing 2** for front seat rail (C), front and back stretchers (D), side seat rails (E), and side stretchers (F). Now, test the fit in the legs' mortises. Then cut the tenons on the actual parts.

3 Lay out the curves on the bottom edges of the front seat rail (C) and side seat rails (E), where dimensioned



3 EXPLODED VIEW



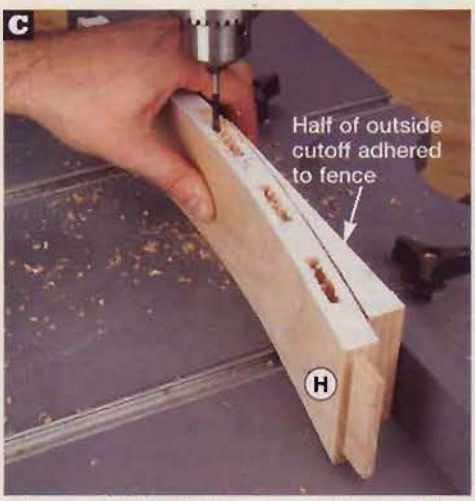
on **Drawing 3**. Bandsaw and sand to the lines.

4 Without changing your tablesaw setup, cut the ¼" tenon *shoulders* on the backrest blanks (G, H), where shown on the backrest full-size front-view half pattern on the *WOOD Patterns*® insert. Also, to give you two test tenons, make the same should cuts on both ends of your 1¾"-thick scrap.

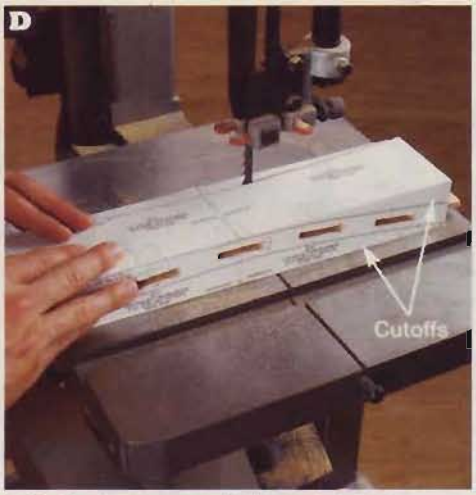
5 Raise the dado blade to ⅜", and make the first *cheek* cuts on the front faces of the backrest blanks and the 1¾"-thick scrap, where shown on the backrest full-size edge-view half pattern.

6 Raise the dado blade to 1⅛", and cut a second tenon *cheek* in the back face of your scrap. Test the scrap tenon's fit in the leg mortises, and make any necessary adjustments. Then, cut the second tenon *cheeks* in the backrest blanks.

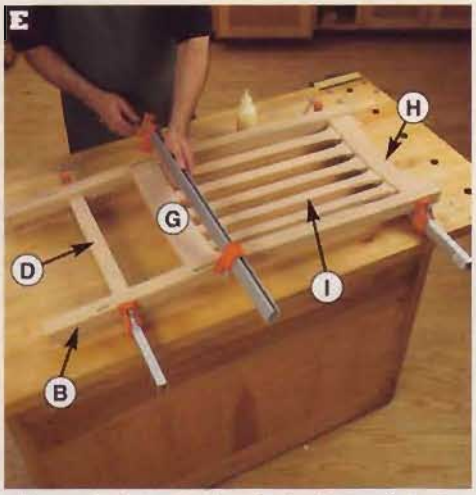
7 Make four copies of the backrest edge-view half pattern and two copies of the front-view pattern. Spray-adhere the edge-view patterns to the top edge of the bottom backrest blank (G) and to the bottom edge of the top backrest blank (H), joining the halves where indicated. Bandsaw the backrests just outside the pattern lines, saving the cutoffs. Then, using a 3"-diameter drum



Adhere half of a backrest's outside cutoff to your drill-press fence with double-faced tape. Using the cutoff as a guide, drill the mortises in the backrests.



With the top backrest (H) sandwiched between its cutoffs, bandsaw the curve on the backrest's top, staying just outside the pattern line.



Glue and clamp the back stretcher (D) and backrest assembly (G/H/I) between the back legs (B). Lay this assembly on a flat surface until the glue dries.

Check for equal diagonal measurements between the legs' inside corners to ensure square. Make sure the front legs are parallel to the back legs.

sander or a random-orbit sander, sand smooth to the pattern lines.

8 To provide a guide for positioning the curved backrests when drilling their mortises for the slats (I), cross-cut one of the backrests' outside cutoffs in half. Then, attach one of the halves to your drill-press fence, as shown in **Photo C**. Using a ¼" Forstner bit, drill the mortises in the backrests, where shown on the patterns and as shown in **Photo C**. Note that the mortises are ¾" wide in the bottom backrest and 1½" wide in the top backrest. Clean up the sides of the mortises and square the ends with a chisel.

9 To cut the curve along the top edge of the top backrest (H), attach the cutoffs to the backrest with double-faced tape. Spray-adhere the backrest front-view patterns to the backrest's face. Then, cut the curve, as shown in **Photo D**. Remove the cutoffs, and sand the edge smooth. Remove the patterns from the mortised edge of the top and bottom backrests.

10 Plane stock to ½" thick for the slats (I). Cut the slats, plus an extra piece to test the tenon cuts, to the size listed. With a dado blade in your tablesaw, cut a ¼" tenon *shoulder* on the top end of the slats and your scrap, and a ⅝" tenon *shoulder* on the bottom end of the slats and scrap, where shown on **Drawing 2**. (The ⅝" shoulder becomes a ¼" shoulder after the slats are cut to shape.) Lower the dado blade to ⅛". Then, cut the tenon *cheeks* on both ends of your scrap. Test the tenons' fit in the top and bottom backrest mortises. Make any necessary adjustments, and cut the tenon *cheeks* on both ends of the slats.

11 Make five copies of the full-size slat end pattern on the insert. Spray-adhere the patterns to the top (wide-tenon) end of the slats (I), aligning the patterns with the tenons' shoulders. Extend straight lines from the pattern lines to the slats' bottoms. Then, bandsaw just outside the lines, and sand to the lines. Remove the patterns.

Assemble the chair

1 Glue and clamp the front seat rail (C) and front stretcher (D) between the front legs (A), and the slats (I) between the bottom and top backrests (G, H). Make certain both of these assemblies are square and flat.

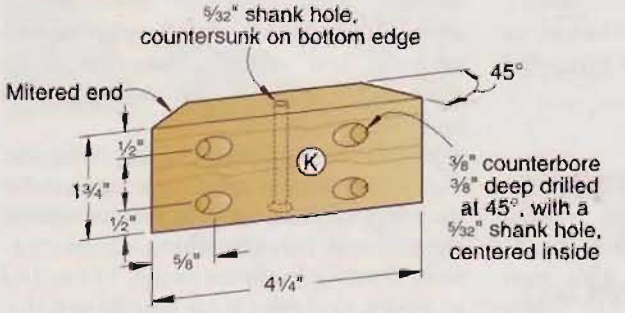
2 Glue and clamp the back stretcher (D) and backrest assembly (G/H/I) between the back legs (B), as shown in **Photo E**, and check for square.

3 Join the front assembly (A/C/D) and the back assembly (B/D/G/H/I) by gluing and clamping the side seat rails (E) and side stretchers (F) in place, where shown on **Drawing 3**. Measure the diagonals to check for square, as shown in **Photo F**. Rest the assembly on a flat surface to dry.

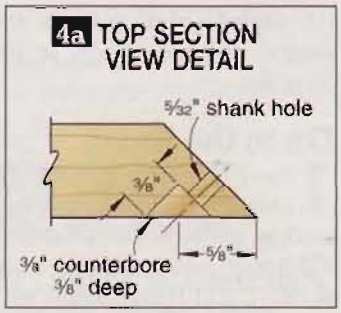
4 Cut the back seat rail (J) to size to fit between the side seat rails (E). Position the rail between the side seat rails with their top edges flush. Then, drill the mounting holes into the back legs (B), and drive the screws.

5 Cut the corner braces (K) to the size listed. Miter the ends, where shown on **Drawing 4**. With the faces of the miters

4 CORNER BRACE



4a TOP SECTION VIEW DETAIL



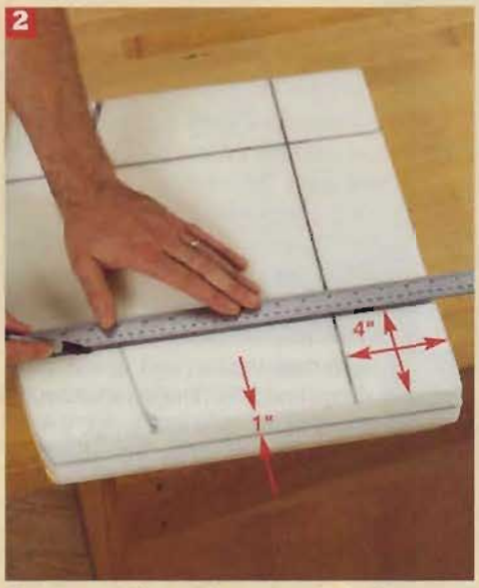
Seat cushions made easy

There's no need to take a back seat and leave upholstering of seat cushions to a pro. In just six simple steps, and using materials readily available at local fabric stores, you can quickly make comfortable, attractive cushions, and enjoy cost-savings to boot.

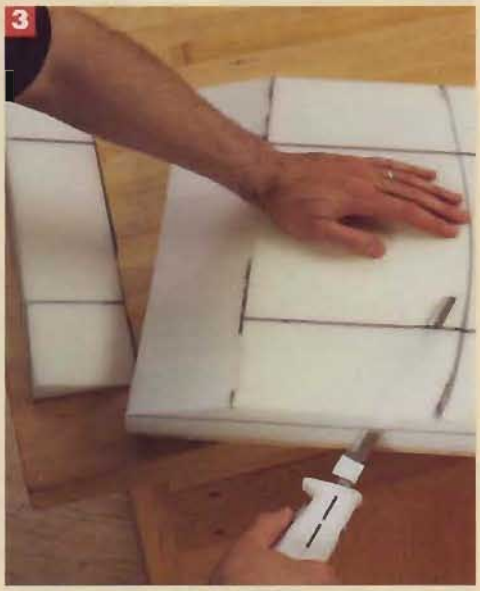
Using this project's dining chair as an example, purchase a 2×24×24" piece of medium-density upholstery foam, and enough high-loft polyester quilt batting and cover fabric of your choice to cut a 21×21" piece of each. (We used a rust-colored, cloth-backed vinyl for our fabric.)

Next, from ½" plywood, cut a 16⅜×17" piece for the seat (L). Using a thin, flexible fairing strip, lay out the curve on the back of the seat to fit the curved bottom backrest (G), where dimensioned on **Drawing 3**. Then, bandsaw and sand the seat to the marked line. To keep the upholstery material from wearing on sharp edges, cut ¾" radii on the seat's corners, and rout ⅛" round-overs along its top and bottom edges. Sand the seat's edges smooth. Now, to complete the cushion, shown at *right*, just follow the six steps *below*.

Adhere the oversize piece of foam to the seat with spray adhesive. Guided by the seat's edges, trim the excess foam with an electric carving knife or serrated bread knife. Be sure to keep the blade cutting vertically.



For the cushion to have rounded edges, remove the foam's square top edges. To do this, first mark cutlines 4" in and 1" down from the foam's top edges with a medium-point, felt-tipped marker and a straightedge.



Using the electric knife or serrated bread knife, cut along the marked lines. Keep the knife's blade simultaneously aligned with the lines marked on both the top and side to form bevels on the foam's top edges.

held flat on a piece of scrap on your drill-press table, drill counterbored holes with shank holes centered inside, where shown on **Drawings 4** and **4a**. Then, turn the parts on edge, hold them with a clamp, and drill the countersunk shank hole centered on the parts' length and thickness.

6 Position the corner braces ⅛" below the top of the seat rails (C, E, J). Using the angled shank holes in the braces as guides, drill pilot holes in the rails, and drive the screws.

On to the finish

1 Sand all the surfaces to 220 grit, and ease the unchamfered edges with a sanding block. Remove the sanding dust.

2 Apply a stain if you wish. (We used ZAR Oil-Based Stain, no. 110 Salem Maple.) Then, apply two coats of a clear finish. (We sprayed on AquaZAR Water-Based Clear Satin Polyurethane, sanding to 320 grit between coats.)

Fashion a seat and cushion

1 To make the seat (L) and your own cushion, follow the instructions in the sidebar "Seat cushions made easy," *above*. If you do not wish to upholster the plywood seat yourself, take the chair, seat, and a copy of the sidebar to an upholstery shop.

2 With the seat and cushion complete, place it on the chair, tight against the back legs (B) and centered side to side on the side seat rails (E). Using the countersunk shank holes in the corner braces (K) as guides, drill pilot holes into the seat (L). Fasten the seat to the braces with screws, where shown on **Drawing 3**.

Written by **Owen Duvall**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine**

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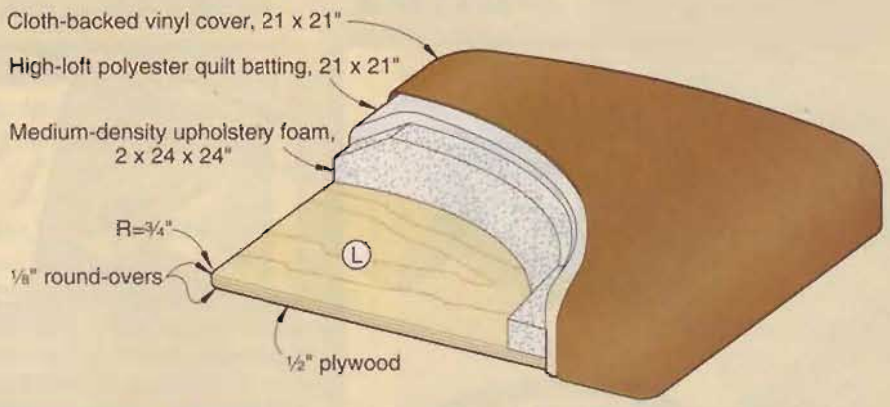
SEAT CUSHION



Place a 21×21" piece of quilt batting on your workbench. Center the seat/foam on the batting. Now, pull the batting up over the foam, and fasten it to the seat with ⅜" staples. Trim the excess batting at the corners.

Center the cushion on the back side of the 21×21" cover. Secure the cover to the seat at the middle of each side with one ⅜" staple. Working from centers to corners, pull the cover onto the seat, and finish stapling it.

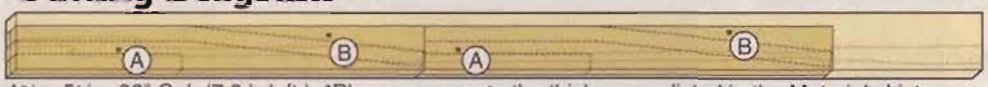
Pinch the fabric together in the corners, and trim the excess about ¾" above the seat. Keeping the remaining fabric taut, fold it, smooth out any wrinkles, and staple it (inset photo). Again, trim away any excess fabric.

Materials List

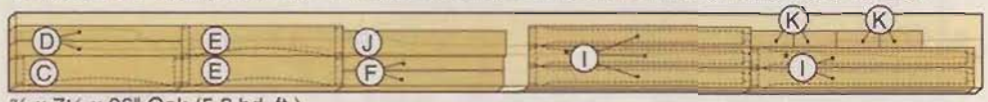
Part		FINISHED SIZE T	W	L	Matl.	Qty.
A	front legs	1½"	1½"	16½"	O	2
B	back legs	1½"	4¼"	40⅝"	O	2
C	front seat rail	¾"	3"	16½"	O	1
D	front and back stretchers	¾"	1½"	16½"	O	2
E	side seat rails	¾"	3"	16"	O	2
F	side stretchers	¾"	1½"	16"	O	2
G*	bottom backrest	1½"	3"	16½"	O	1
H*	top backrest	1½"	3"	16½"	O	1
I	slats	½"	2"	22⅛"	O	5
J	back seat rail	¾"	2½"	16¼"	O	1
K	corner braces	¾"	1¾"	4½"	O	4
L	seat	½"	16⅜	17"	BP	1

*Parts initially cut oversize. See the instructions.

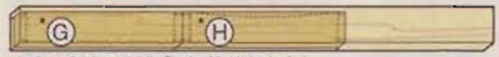
Cutting Diagram



1¾ x 5½ x 96" Oak (7.3 bd. ft.) *Plane or resaw to the thicknesses listed in the Materials List.



¾ x 7¼ x 96" Oak (5.3 bd. ft.)



1¾ x 3½ x 48" Oak (2.3 bd. ft.)

Materials key: O–oak, BP–birch plywood.

Supplies: #8×1" flathead wood screws (16); #8×1¼" flathead wood screws (4); #8×2¼" flathead wood screws (4); spray adhesive; double-faced tape; medium-density upholstery foam, 2×24×24"; high-loft polyester quilt batting, 21×21"; cloth-backed vinyl cover, 21×21"; ⅜" staples.

Blades and bits: Stacked dado set, ¼" Forstner bit, ⅛" round-over router bit.

½ x 24 x 48" Birch plywood

rust busters

Discover which of fourteen products rid rust from cast-iron surfaces and stop it from returning.

We taped off cast-iron tablesaw extension wings into equal sections, misted them for 24 hours to create rust, then removed the corrosion with various products.

To a woodworker, rust is a four-letter word. Unless you live in the dry climates of the Southwest, you must always be vigilant against the red menace. With at least nine products marketed to woodworkers as rust removers and preventatives, we decided to see how well they work, and uncover which products deserve a spot in your shop.

THE RUST-MAKING TORTURE CHAMBER

To accelerate the formation of rust, we built this "wet box" and connected it to a cold-air vaporizer. The box's clear acrylic lid allowed us to observe the progress of the test, while a drain hose allowed excess moisture to trickle away.

Before we could remove rust, though, we needed to create a consistent coat of it on two tablesaw extension wings. We sanded the wings to remove any previously applied rust protectants, then divided the surfaces into equal-size areas for each remover. We built the "wet box," shown at *left*, and pumped moisture-laden air into the sealed box for 24 hours. After letting the rust stand for a day, we tested each of the removers and combination products (those designed to both remove rust and prevent its return) shown in the chart on the *next page*.

During this test, we noticed that some of the freshly cleaned surfaces began to haze over with orange rust within minutes. This so-called "flash rust" proves why removing rust isn't enough; in most cases, you need to apply a protectant right away.

Continued on page 88

Proving the protectants

To test the effectiveness of rust protectants, we sanded, cleaned, and sectioned off another pair of cast-iron tablesaw wings, and then applied the products according to the manufacturer's instructions. Next, we put the test pieces into the wet box, pumping moisture in continuously, noting when rust began to form and when the test area was completely rusted over.

The series of photos, *below*, show the outcome and the clear difference in rust-prevention products. Remember that our tests accelerated rust formation far beyond what you can expect in even the most rust-prone areas of the country. (Much of the time in the wet box, water was actually standing on the test surfaces.) Even the protectants that failed in a few minutes in these conditions should last much longer under normal circumstances.

FOURTEEN

	PRODUCT	APPLICATION METHOD	TIPS FOR USE
REMOVERS	BOESHIELD RUST FREE	Spray on, scrub with synthetic abrasive pad or steel wool. Wipe dry with clean cloth.	For heavy rust, apply and let it stand for 5–20 minutes before scrubbing.
	BULLFROG RUST REMOVER	Brush on with disposable foam brush, let stand for one hour, rinse with water.	Before rinsing, scrub with a synthetic abrasive pad for better results.
	KLINGSPOR SANDLFEX BLOCKS	Rub rusted area with blocks to "erase" rust. Start with coarse block, then medium, then fine.	Keep a shop vacuum handy to suck up dust.
	NAVAL JELLY	Pour onto surface, let stand for 10–20 minutes, rinse with water.	Before rinsing, scrub with a synthetic abrasive pad for better results.
	WD-40	Spray on, scrub with synthetic abrasive pad or steel wool. Wipe dry with clean cloth.	Synthetic pads left a nicer-looking finish on the tabletop than steel wool.
	MINERAL SPIRITS	Soak steel wool or synthetic abrasive pad, and then scrub. Wipe with clean cloth.	Let it soak for about 2 minutes before scrubbing for best results.
PROTECTANTS	BOESHIELD T-9	Spray on, allow to dry 1 hour before use.	The test surface wasn't completely dry after one hour, so we gently wiped it dry.
	BOSTIK TOPCOTE	Spray on, allow to dry, then wipe off with clean cloth.	For best results, recoat and buff again.
	BULLFROG FASTWAX WITH RUST BLOCK	Spray on, then wipe off with a clean cloth.	You needn't wait for the protectant to dry before wiping it off.
	SLIPIT TOOL & SURFACE LUBRICANT	Spray on, then wipe off with a clean cloth.	None
	JOHNSON'S PASTE WAX	Apply with pad, allow to haze, then wipe with a soft cotton cloth.	None
	CARNUBA WAX	Apply with damp pad, allow to haze, then wipe with a soft cotton cloth.	None
COMBO*	BULLFROG TOOL WIPES	Wipe surface with this premoistened towelette and let dry.	Wipe the surface to wet it, then scrub with steel wool or pad, then wipe again.
	EMPIRE TOPSAVER	Spray on, scrub with synthetic abrasive pad, then wipe dry. Re-spray, and buff surface.	Refold the rag to a clean area frequently for best results.

* Combination products designed to remove rust *and* protect from future corrosion

NOTES:

1. Keep all chemicals out of the reach of children. When using chemicals, always wear gloves and protective eyewear.

BEFORE

We applied a different rust protectant to each of the eight sections of these tablesaw extension wings and put them into the wet box. At this point, the wings have been treated but subjected only to normal humidity conditions.

AFTER 40 MINUTES

Flash rust already covers three of four sections of the back wing, and has started creeping across the center two sections of the front wing.

AFTER 24 HOURS

Except for the section treated with Boeshield T-9 (right foreground), all sections have completely rusted over.

RUST-BUSTERS UNDER THE MAGNIFYING GLASS

SAFETY (1)	PERFORMANCE SUMMARY	RUST-REMOVAL EFFECTIVENESS (2)	RUST-PREVENTATIVE EFFECTIVENESS (2)	EASE OF APPLICATION (2)	PRICE (3)	FOR MORE INFORMATION
Nonflammable, nontoxic, biodegradable	Easy to use, but it took five applications to completely remove the rust.	B	N/A	A	$9 for 8.5 oz.	800/962-1732 www.boeshield.com
Low odor, nonflammable, nontoxic, biodegradable	Effective, but rinsing with water is difficult and sloppy on stationary-tool tables, such as on a jointer or tablesaw. Emits vapors that prevent flash rust from returning.	D	N/A	C	$9 for 16 oz.	800/426-7832 www.bull-frog.com
The only non-chemical rust solution in our test.	These blocks are tops for spot rust or hand tools, but they require a lot of elbow grease for larger areas, such as tabletops.	B	N/A	C	$10 for 3 blocks	800/228-0000 www.woodworkingshop.com
Skin and eye irritant. Use in well-ventilated area.	Rinsing with water is difficult on stationary tools, and the product discolored our test piece, turning it a dull gray. All in all, the results don't justify the hassle.	D	N/A	D	$3 for 8 oz.	800/321-0253
Flammable	For light rust, this is a quick fix, but it's not as effective on heavy rust.	C	N/A	A	$2.50 for 11 oz.	888/324-7596 www.wd40.com
Flammable	Easy to use, but it took four applications to completely remove the rust. On heavily rusted surfaces, we couldn't completely remove the rust using mineral spirits.	C	N/A	A	$4 for 1 gallon	Available anywhere coatings and solvents are sold
Extremely flammable	After only 24 hours in the wet box, T-9 stood head and shoulders above the other protectants, as you can see in the photo sequence, at *left*. Clearly, T-9 is the best protectant in the test.	N/A	A	A	$12 for 12 oz.	800/962-1732 www.boeshield.com
Extremely flammable	Easy to use, and has a pleasant smell. It protected a little better than paste wax and carnauba wax in our test.	N/A	C	A	$14 for 11 oz.	888/603-8558, ext. 7423 www.bostikfindley-us.com
Nonflammable, nontoxic, biodegradable	About as effective and easy to use as TopCote. However, it's much safer, especially around pilot lights and other possible ignition sources.	N/A	C	A	$8 for 32 oz.	800/426-7832 www.bull-frog.com
Nonflammable, nontoxic	Of all the products sold to protect against rust, this one was least effective, with rust returning within 15 minutes in the wet box. Probably effective if applied regularly.	N/A	D	A	$10 for 16 oz.	845/691-8400 www.slipit.com
Nonflammable, nontoxic	In our extreme test environment, neither of these products held up well, with rust returning in 20 minutes. However, applied regularly, both would probably be somewhat effective.	N/A	D	B	$5 for 16 oz.	800/558-5252 www.scjbrands.com
Nonflammable, nontoxic		N/A	D	B	$7 for 12 oz.	Available anywhere coatings and solvents are sold
Low odor, nonflammable, nontoxic, biodegradable	It's a tidy process, but the wipes tend to dry out in their container and work much better with the aid of an abrasive pad or steel wool. Less effective on heavy rust, and size is better suited to surface rust on hand tools.	B	B	A	$9 for 25 wipes	800/426-7832 www.bull-frog.com
Flammable	Removed rust as well as any dedicated remover, and fared pretty well as a protectant, so it's a good one-stop product for both tasks. Everything you need comes with the kit, including gloves, abrasive pad, and wiping cloth.	A	B	B	$20 for 8 oz.	866/700-5823 www.empiremfg.com

2. A Excellent; B Good; C Average; D Below average; N/A Does not apply to this product.

3. Prices current at time of article's production and do not include shipping, where applicable.

The best of the rust busters

None of the products we tested did away with heavy rust with only one application. So for cleaning a large, heavily oxidized surface, such as a jointer table or tablesaw top, your first step should be to sand away as much as you can, then clean it with Empire TopSaver or Boeshield Rust Free. Both products proved easy to use with little mess. TopSaver also did well in the protection test, so it's our top choice for a combination product. For small areas of spot rust, we found ourselves going back to the Klingspor Sandflex Blocks. The rust ring caused by an errant soda can on a humid day came off quickly with these abrasive blocks, then vacuumed away.

There's only one choice for protectant as far as we're concerned: Boeshield T-9. After 24 hours in the wet box, the wing section treated with T-9 was almost as clean as when it went in. We were curious to see how long it would take for this area to rust over, as the others did in a day, so we continued to pump moisture into the box. After 380 hours in this extreme environment, rust finally overtook the T-9 protected area.

Boeshield Rust-Free

Boeshield T-9

Empire TopSaver

Written by **Dave Campbell** with **Dean Fiene**

smash-hit

CD storage

BUILDING TOMORROW'S WOODWORKERS

WAY COOL Woodworking Projects

The CD storage units featured in the photo, *above*, are made from cherry and maple. As an alternative, you can build them from less expensive Baltic birch plywood, and have the child dye them with bright colors, like the ones shown at *left*, and as later explained.

Here's a project that really stacks up.

This modular storage system can grow along with a CD collection. Just add more cases, bases, and lids as needed. You can place up to six interlocking cases on a base. Each case holds 10 CDs, which pop out with the touch of a finger.

Have a child or grandchild who's fascinated with woodworking and magically appears in your workshop every time a tool whines and whirs? I do. He's my eight-year-old son, David. To keep his interest growing, I let him help with my projects, doing operations he can perform safely. And for some time now, I've hunted for a hip kid's project that we can build together—something he'll use and feel he created.

This snazzy, stackable, and easy-to-build CD storage piece, designed by Kevin Boyle, our kid-at-heart Senior Design Editor, fills the bill. David and I spent an afternoon constructing it in the *WOOD*® magazine shop, as shown here. He said the experience was "sweet." No doubt your aspiring young apprentice will find it the same. Now, round up him or her, and get ready to share an awesome building and learning experience together.

Owen Duvall

Owen Duvall, Projects Editor

For the board feet of lumber and other items needed to build this project, see page 93.

Note: *This article is presented in a way that makes it easy for you and a child to build this project together. The first section details cutting operations for you to prepare the parts. The next section presents steps you can do with the child to complete the parts and assemble and finish the unit. Except where noted, we feel the procedures in this section, which include limited power-tool operations, are safe for an eight-year-old to perform with adult supervision. Depending on the child's age, maturity, confidence, and skills, you may want to further restrict or increase the hands-on involvement as appropriate.*

Start by preparing the project parts

1 With your young apprentice observing from a safe distance, cut the case sides (A) and tops and bottoms (B) to the sizes listed in the **Materials List** plus 1" in length. Angle your tablesaw blade to 45°. Then, miter-cut the parts to finished lengths.

Note: *The* **Materials List** *shows the quantities of parts needed to construct three CD cases, a base, and two lids. You can make a two- or four-case unit simply by adjusting the quantities of case parts and dowel feet. Want even more storage capacity? Just lengthen the base in increments of 6¼" and drill the necessary holes, where dimensioned on* **Drawing 1**, *to hold additional cases.*

2 From ¼" birch plywood, cut the backs (C) to size. Then, cut a ¼" groove ⅛" deep and ¼" from the back edge of the sides, tops, and bottoms on their *inside* face to receive the backs. (We cut the groove with a standard blade in two passes to fit the plywood exactly.) Finally, cut the lids (D) and base (E) to size.

Team up with your young partner

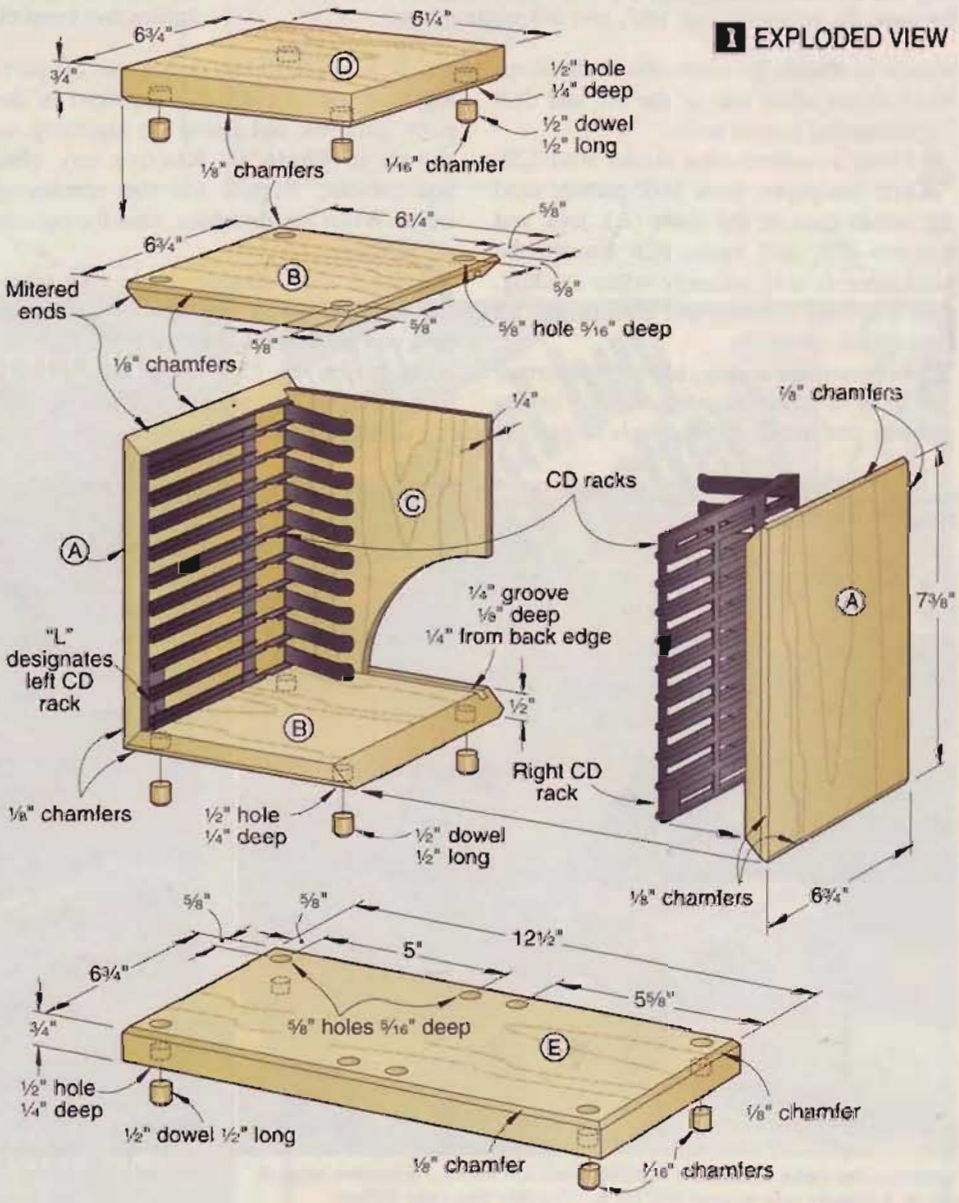
1 To drill the ½" holes ¼" deep in the *bottom* face of the three case bottoms (B), two lids (D), and base (E) for the dowel feet, where shown on **Drawing 1**, first chuck a ½" Forstner bit in your drill press. Then, show the child how you position the drill-press fence and a stopblock to locate the holes ⅝" in from the parts' corners. With a depth stop set for the ½"-thick case bottoms, let the child drill the holes in them, as shown in **Photo A**. Now, reset the depth stop for the ¾"-thick lids and base, and have the child drill the holes.

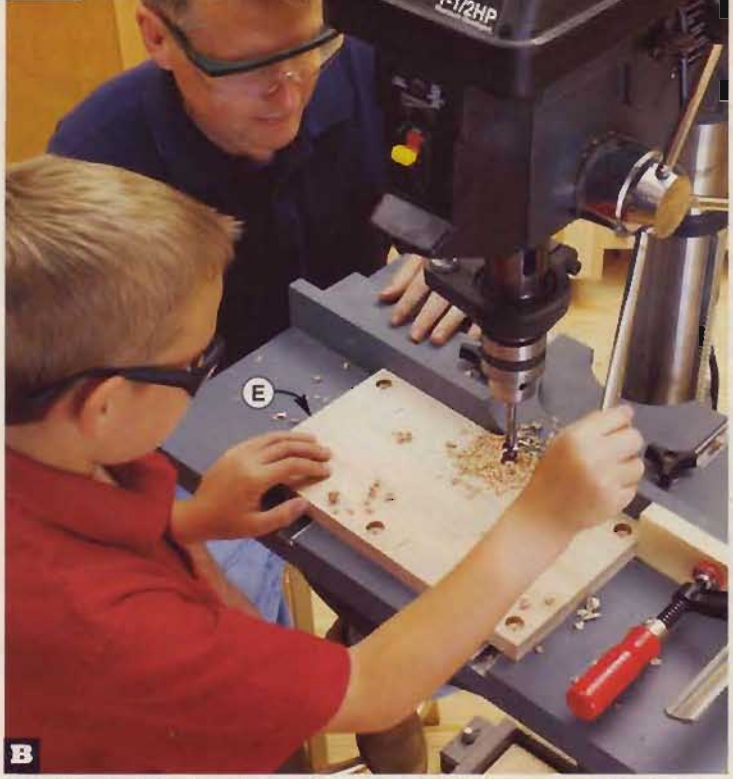
2 Refit the drill press with a ⅝" Forstner bit. Using the same fence and stopblock setup and resetting the depth stop, have your partner drill ⅝" holes 5/16" deep in the *top* face of the three case tops (B) and base (E) at their corners, where shown. The larger ⅝" holes compensate for minor misalignment of the ½" holes for the dowel feet in the case bottoms and lids.

3 To drill the two pairs of ⅝" holes 5⅝" from the ends of the base (E), where shown, reposition the stopblock to one side of the bit, where required. Have your partner drill a pair of diagonally opposite holes, as

With the case bottom (B) held tight against the drill-press fence and stopblock, drill a ½" hole ¼" deep in each corner of the part.

1 EXPLODED VIEW





With the stopblock positioned 5⅝" from the bit's center, drill a hole in the base (E), rotate the part 180°, and drill another hole.

While checking for square and verifying tight mitered corners, tighten two band clamps around the case to secure it.

shown in **Photo B**. Now, move the stopblock to the other side of the bit, and drill the remaining pair of holes.

4 Using a random-orbit sander with 220-grit sandpaper, have your partner sand the inside face of the sides (A), tops and bottoms (B), and backs (C). Ensure the workpiece is held securely while sanding, and use long overlapping strokes for an even finish.

5 To assemble a case, have your partner apply a small amount of glue in the grooves and to the mitered ends of parts A and B. Then, help him or her join the parts together with a back (C) captured in the parts' grooves, and clamp the assembly, as shown in **Photo C**. Remove any glue squeeze-out. Repeat for the remaining cases. When the glue dries, sand the outside of the cases.

6 Chuck a 45° chamfer bit in your table-mounted router, and show your partner how you set the bit height for a ⅛" chamfer. Next, review the "5 essential tips for safe routing," *opposite page, top*. Then, providing an assisting hand, let your partner rout the case edges, as shown in **Photo D**. Now, rout the edges on the bottom face of the lids (D) and the top face of the base (E).

7 To make the chamfered dowel feet for the case bottoms (B), lids (D), and base (E), first cut a ½" birch dowel 36" long in half. Then, using a disc sander and the super-simple dowel chamfering jig shown on *page 12*, have your partner chamfer the dowels' ends, as shown in **Photo E**.

Next, using a miter box, crosscut ½"-long feet from the dowels, as shown in **Photo F**. Repeat the process to form 24 feet.

Keeping the case assembly tight against the fence, move the assembly at a steady rate across the bit to chamfer the case edges.

Holding the dowel flat on the jig's base and tight against its angled stop, rotate the dowel 360° to sand a 1/16" chamfer on its end.

5 essential tips for safe routing

Although basic router safety procedures may be second nature to you, they're likely to be new to the child. Review these precautions with the youngster, and be sure he or she understands them before routing the parts' edges.

1. Make sure the router bit, cutting-depth lock, and router-table fence are secure.
2. Position split fences as close as possible to the bit to reduce exposure, and keep hands safely away from the bit.
3. Wear safety glasses or goggles and hearing protection.
4. Remove all jewelry and loose clothing. Wear a short-sleeve shirt or roll up long shirtsleeves.
5. Hold the workpiece securely against the fence, and feed it slowly and steadily from right to left against the bit's rotation.

Materials List (for 3 cases)

Part	FINISHED SIZE T	W	L	Matl.	Qty.
A* case sides	½"	6¾"	7⅜"	C	6
B* case tops and bottoms	½"	6¾"	6¼"	C	6
C backs	¼"	5½"	6⅜"	BP	3
D lids	¾"	6¾"	6¼"	M	2
E base	¾"	6¾"	12½"	M	1

*Parts initially cut oversize. See the instructions.

Materials key: C–cherry, BP–birch plywood, M–maple.

Supplies: ½" birch dowel 36" long, five-minute epoxy.

Blades and bits: ½" and ⅝" Forstner bits, 45° chamfer router bit.

Sources

CD Racks. Pop-out CD racks, no. 35875, $3.99 pr. (3 pr.). Call Rockler, 800/279-4441, or go to www.rockler.com.

Now, glue the feet in the holes in the bottom face of the parts with the chamfered ends exposed.

8 For the cherry and maple unit, apply three coats of a clear finish. (We used Deft aerosol Satin Clear Wood Finish. For safety reasons, we recommend that the adult do this in a well-ventilated area.) For a plywood unit, let your partner dye the project with bright colors, making sure he or she wears protective rubber gloves. (We used Homestead's water-soluble TransFast Dye Powders, in the accent colors blue, lemon yellow, dark green, and scarlet red, as shown in the photo on *page 90*. The dyes are available at Woodcraft. Call 800/225-1153 or go to www.woodcraft.com.) You also can use food coloring as a less expensive option, if you wish. When the dyes dry, apply three coats of clear finish.

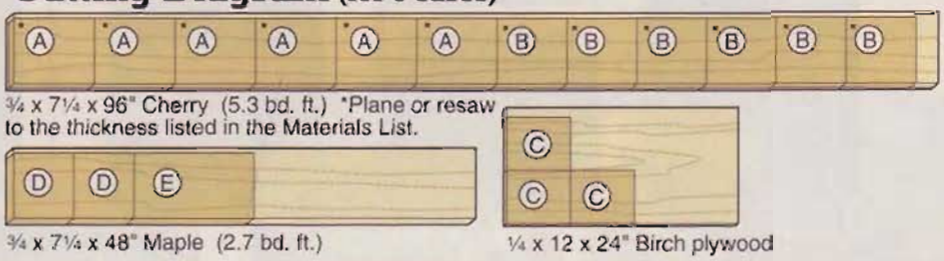
9 To epoxy the CD racks in place, first make spacers to keep the racks pressed against the sides (A) while the epoxy cures. Determine the spacers' size by positioning a pair of racks in a case tight against the sides and measuring the distance between the racks' inside faces. (Ours measured 4⅝".) Remove the racks. Then, from scrap ¼" plywood, cut six spacers to your measured width plus 1/32" (to ensure a tight fit) and to a length of 6". Now, let the child drill two 1" finger holes through the spacers, locating the holes' centerpoints 1" from the spacers' ends and centered on their width.

10 Mix a small amount of five-minute epoxy. Then, have your companion put a dab of it on the back of a pair of racks near each corner. With a case on its back, solicit help to install the racks against the sides, where shown on **Drawing 1**, tight against the case bottom (B) and back (C). Secure these with two spacers, as shown in **Photo G**. Repeat for the remaining cases. When the epoxy cures, remove the spacers.

11 Finally, let your proud partner assemble the unit and load it with CDs. To easily remove a CD, press on its case with a finger, lift up slightly, and release. The racks' springlike fingers will pop out the CD.

Written by **Owen Duvall**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine**

Cutting Diagram (for 3 cases)


A A A A A A B B B B B B
¾ x 7¼ x 96" Cherry (5.3 bd. ft.) *Plane or resaw to the thickness listed in the Materials List.
D D E
¾ x 7¼ x 48" Maple (2.7 bd. ft.)
C C C
¼ x 12 x 24" Birch plywood

Using a stopblock clamped to the miter-box fence, cut the ½"-long feet from the chamfered ends of the dowels.

Insert two spacers in the case, one at the back and the other at the front, to wedge the epoxied CD racks against the sides.

cat's meow scrollsawn plaque

Oh, what a relief this is—with cutout cats of varying thicknesses and a simple one-piece frame.

Plaque viewed from back side

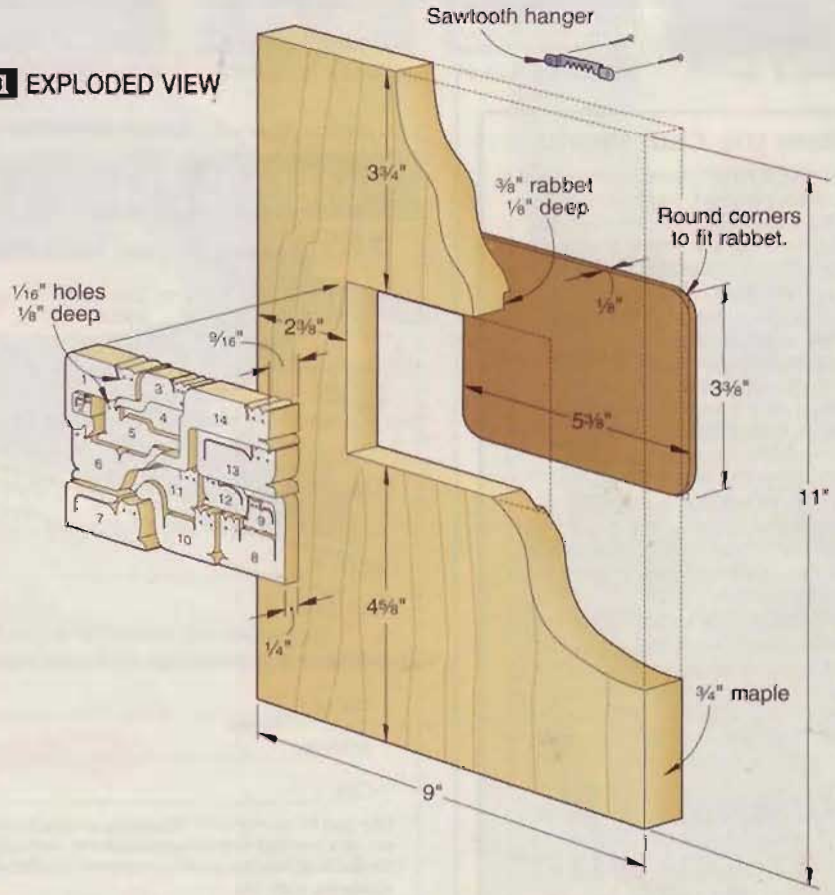
Cut a ¾"-thick piece of stock (we used quilted maple) to 9×11". Use a square to lay out and mark the left and top edges of the area to be scrollsawn, where dimensioned on **Drawing 1**. Make a photocopy of **Drawing 2** on *page 98*, and spray-adhere it to the cutout block location on the maple blank. Drill a 1/16" blade-start hole, where shown. Now, with a #12 scrollsaw blade, cut the block from the blank. Sand the edges of the resulting opening smooth.

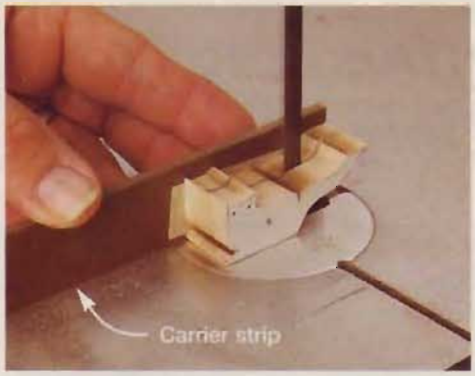
Drill a pair of 1/16" holes 1/8" deep for each cat's eyes where marked on the full-size pattern. Use the head of a finish nail to indent eyes for cat no. 2. Cut the cats to shape from the block in the sequence numbered on the pattern. Rout a 3/8" rabbet 1/8" deep along the back inside edge of the blank opening, where shown on **Drawing 1**. Now, cut a piece of 1/8" hardboard to fit the rabbeted opening, and glue it in place.

To create cats of varying thicknesses, cut a strip of wood to 1¼×12". One at a time, apply double-faced tape to a cat and press it to one end of the carrier strip. Cut or sand each cat to the thickness noted on

Continued on page 98

1 EXPLODED VIEW

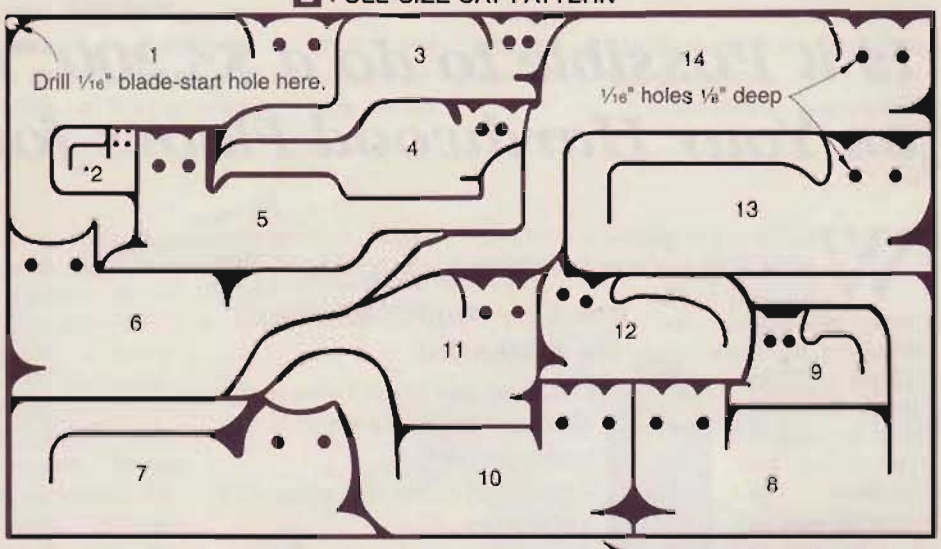




the Thickness Key next to **Drawing 2**. (As shown in the photo *above*, the carrier strip let us bandsaw the cats safely.) Sand the frame and each scrollsawn cat up to 220-grit abrasive. Glue the cats to ⅛" hardboard in the configuration shown on **Drawing 2**. Center and attach a sawtooth hanger on the plaque back 1" down from the top. Apply a clear finish. (We used spray satin polyurethane.)

Project Design: Jerry Krider,
Claywood Creations, Columbia City, Ind.

2 FULL-SIZE CAT PATTERN



* Indent eyes for cat no. 2 using a finish nail.

Blank cut from ¾" stock

Thickness Key

1	9/16"	6	7/16"	11	¼"
2	¾"	7	9/16"	12	⅜"
3	7/16"	8	¼"	13	7/16"
4	¼"	9	3/16"	14	9/16"
5	⅜"	10	5/16"		

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short cuts

News and notes from the woodworking world

Here's looking at you

Can't find what you want? Then make it out of wood. That's the tack Dave McHuron of Concord, California, took when he went shopping for a spotting scope in order to view wildlife from his home's back deck. "All the ones I looked at were very expensive or junk," he says. Dave made the intriguing scope shown at *right* the old-fashioned way—using only hand tools. But wood wasn't the only material he worked with. "Altogether," he says, "I cut the glass, ground and polished the lenses, designed and built the housing and stand, and then assembled the entire works."

With the 25mm eyepiece, Dave achieves 93× magnification; switching to a 17mm eyepiece, he gets 157×; his 10mm eyepiece yields 237×.

Seeing is believing with Dave McHuron's home-made spotting scope. Built from oak, myrtle, and walnut, the lens housing raises to 60°, rotates horizontally 360°, and angles up and down as desired.

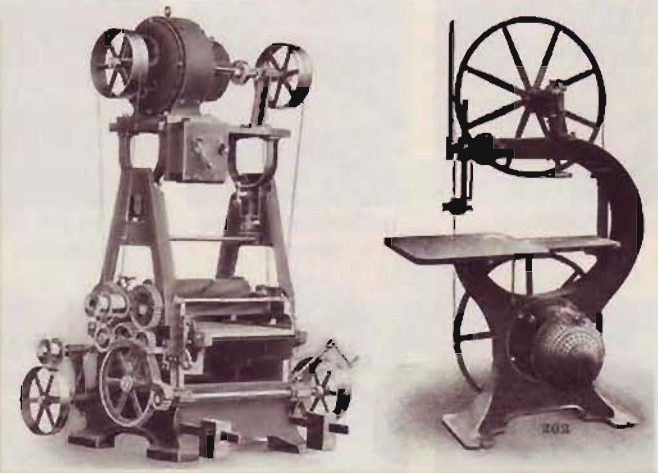
Test your workshop smarts

Put your woodworking wits to work by solving these trying questions. Then, tune into the next issue of *WOOD®* magazine's Short Cuts, or go right now to www.woodmagazine.com/shortcuts to find the answers.

■ **What's the difference between water-resistant and waterproof glues?**

■ **What makes a better power tool table, cast-iron or aluminum?**

■ **Can you guess the diameter of the largest turned wooden bowl?**



These two electric-powered machines exemplify turn-of-the-century technology. The surfacer sander, left, runs off a motor-powered drive shaft; the bandsaw, a direct-drive motor.

Answers to the questions in issue 153:

■ **What was the first woodworking tool powered by electricity?**

According to Keith Rucker, an antique tool expert from Tifton, Georgia, the first electric handheld woodworking tools were drills. German-based Fein claims credit for the first handheld power tool, below, *an electric hand drill made in 1895.*

The very first handheld power tool was an electric drill manufactured by Fein.

With regard to electric-powered stationary woodworking tools, the picture grows murky. Just before the turn of the century, stationary machines were driven by steam- or water-powered line shafts. Smaller shops were at a big disadvantage because they simply could not afford boilers and steam engines or water wheels.

Consequently, smaller shops began to experiment with driving individual machines using electric motors. For more on old woodworking machines, go to www.owwm.com.

■ **When an oil-based varnish skins over in the can, does that mean the finish is no longer any good and should be disposed of?**

"Absolutely not," says finishing guru Bob Flexner of Norman, Oklahoma. "It can skin over five times in five years and the varnish underneath will still be usable." You will, however, need to take care removing the skin so you don't get detracting pieces in the remaining finish. "Strain the varnish for the next use," Bob advises. "I use my wife's panty hose for this. It works great."

The skin that forms over the surface of oil-based varnishes is not damaging to the material below.

■ **What is the heaviest wood known to man?**

Generally speaking, many experts agree that lignum vitae is the heaviest wood. One board foot of it weighs 6.4 lbs. By contrast, a board foot of Ponderosa pine, weighs 2.67 lbs.

The weight of lignum vitae far exceeds that of much lighter Ponderosa pine. That's why it rests on the bottom of this water-filled container while the other wood floats.

Continued on page 102

In woodworking, hope springs eternal

Crime and drugs can take their toll on the minds and spirits of youths growing up on the District of Columbia's mean streets, where high-school dropout rates average around 40 percent. Many youths in these neighborhoods face unemployment and, even worse, homelessness. Covenant House Washington, a nonprofit organization committed to caring for at-risk young people, aims to improve this picture one young person at a time, via woodworking, and the volunteer efforts of dedicated skilled craftsmen.

Through the organization's Artisans program, according to manager Matt Barenholtz, youths between 16 and 21 years old enroll in a six-month woodworking class during which they master the skills needed to apply for an entry-level position in a cabinet shop or other woodworking enterprise. While enrolled, youths train in a workshop setting using several machines, as well as hand tools. As the program picks up steam, however, the need for new volunteer craftsmen increases, and that's where you can help.

If you live in the area and would like to share your knowledge with these budding woodworkers, here's how to participate. Begin with a tour of the Covenant House Washington Artisans' workshop to glimpse at the young craftsmen and craftswomen at work. You can arrange it by calling 202/610-6519 or 202/610-9621. Or you can e-mail the workshop facility at artisans@chdc.org. The workshop is located at 1235 Kenilworth Avenue, NE, Washington, DC 20019.

Students enrolled in Covenant House Washington's Artisans' program show off the toddler chairs they constructed for a local charity.

GREAT IDEAS FOR YOUR WOODWORKING CLUB

Success secrets from the Long Island Woodworkers

Any woodworking club that's worth its weight in pink ivory has activities and policies in place that guarantee its long-term success. The Long Island Woodworkers' Club (LIWC) of New York is one such organization. Boasting a membership of more than 250, the LIWC puts on an impressive event every April—the Furniture and Woodworking Show. It includes workshops, tool vendors, and members' works that are judged by such woodworking notables as Frank Klausz, Ian Kirby, Struther Purdy, and Mario Rodriquez. This year, the event lured 4,000 attendees and was deemed the largest in the club's history.

Another successful event is the club's round-robin meetings held twice a year. Here, according to board member Daryl Rosenblatt, "Several tables are set up where volunteer members perform how-to demos on topics that range from pen turning to applying a French polish to working with dovetail jigs."

Members of the Long Island Woodworkers' Club look on as club president Gabe Jaen explains how to tune up a hand plane during a round-robin meeting held in June 2003.

Daryl shared still more ideas behind his woodworking club's success:

- Encourage broad volunteerism and participation in club activities and special causes, such as Toys for Tots.
- Don't place restrictions on the kind of woodworking done in the club. Include scrollsawing, woodturning, and so on.
- Keep things social by scheduling picnics and other fun events, and be sure to invite spouses.
- Communicate with members through a club newsletter and Web site.

To learn more about the LIWC, visit it at www.liwoodworkers.org.

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Forever an handy resource, the *WOOD*® magazine online searchable index lets you find the issue and page number of feature, technique, tool, and project articles from all previous issues. If you're counting, that's a full 19-years worth of valuable woodworking information. But what if you want the actual article from a past issue found in the online index?

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Bringing home the gold

For the second consecutive year, *WOOD* magazine received the prestigious Eddie award for editorial excellence. Competing in the "Consumer Hobbies" division, *WOOD* magazine won the highest Eddie—at the "gold" level. Each year, *Folio*, a leading magazine-industry trade publication, sponsors the international competition. Participating magazines are judged on how well they articulate and adhere to their mission statement, content quality, overall design, and production.

one puzzling woodworker

Building these intricate wooden puzzles takes Tom Lensch hours of exacting work. And if you think that's tough, just try solving one.

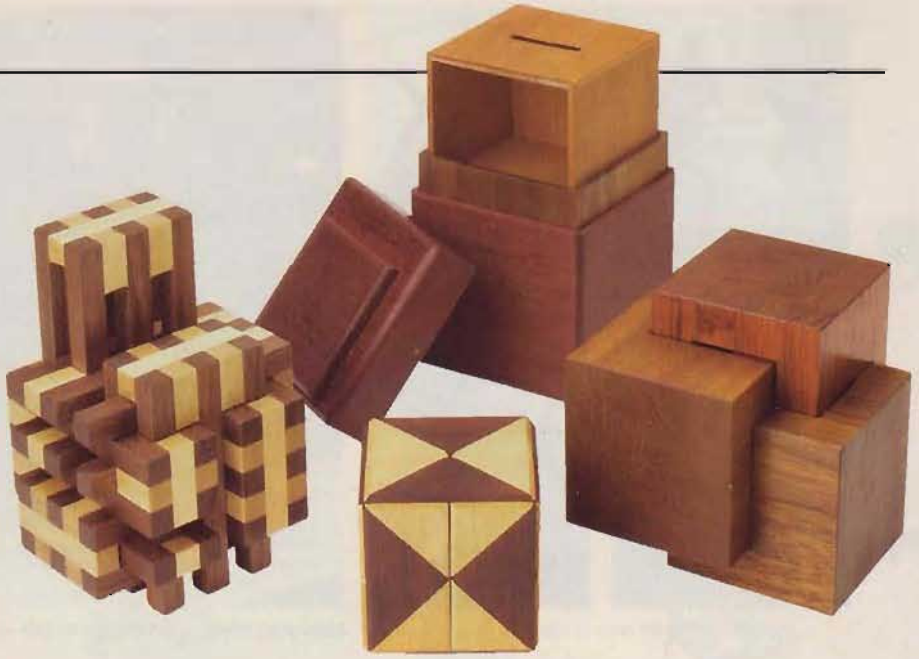
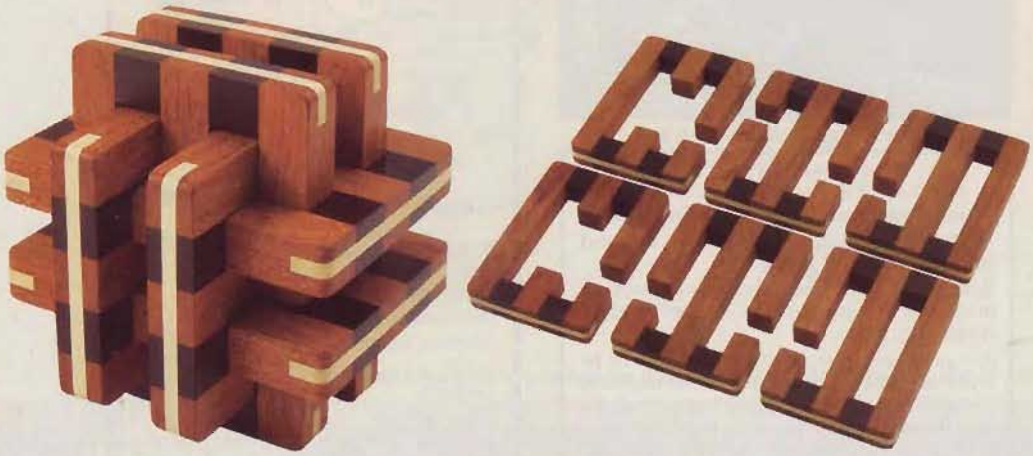


Photo: Mark Garber Photography

Tom Lensch has to be part mathematician, part woodworker to design and build the intricate puzzles that surround him in his shop.

Tom Lensch always loved puzzles and collected them for years. Then, in 1989, he grabbed a book, a bit of wood, his few modest tools, and began making puzzles of his own. Today, this retired civil engineer from Dayton, Ohio, produces the beauties you see here, plus many more styles that he sells to puzzle collectors around the world for as much as $200 apiece.

Whether crafted from his own design, or built under agreements with several of the worlds most-respected puzzle creators, the puzzles Tom makes are as beautiful as they are baffling. All feature interlocking parts that often take a dozen or more moves to disassemble. A puzzle called "Torture," *below*, for example, could keep you busy for days figuring out the complex sequence of moves required to get it apart. Then you'd face just as much challenge getting it back together.



"Torture" lives up to its name, requiring 17 moves to disassemble and as many to put back together. This 3x3" cube features six pieces made from bubinga, ebony, and holly.

Careful control helps get the proper fit

Making puzzles fit together properly—without any play or binding—requires tight tolerances. To achieve them, Tom often measures in thousandths of an inch. "I know wood can expand and contract more than that with changes in humidity, but I want the pieces sized exactly when I build the puzzle," he says. Tom studies wood and chooses species that have consistent grain structure and good stability to help minimize this wood movement.

Many of Tom's creations, including a model known as "Triumph," *page 106*, also require complex angles that have to be accurate to within a fraction of a degree. One puzzle he creates requires a cut at 70.529°!

Achieving these superaccurate results, and being able to repeat them, requires exacting tablesaw and bandsaw setups. Tom accomplishes these tasks using setup gauges he makes from acrylic plastic.

When cutting puzzle parts, Tom has to securely hold pieces that may be less than 1" square. To do this, he employs a number of homemade jigs—sometimes as many as six or seven for a single puzzle. And he cuts similar pieces for multiple puzzles before changing setups to minimize the chances for error.

Because the puzzle pieces have to be shaped so precisely, many can't be sanded after cutting. That means Tom needs clean, smooth cuts. He prefers Forrest blades for his tablesaw and radial-arm saw, and he has them resharpened by the company. On the bandsaw, he uses blades with teeth made of silicon carbide.

Continued on page 106

Assembly and finish prove keys to success

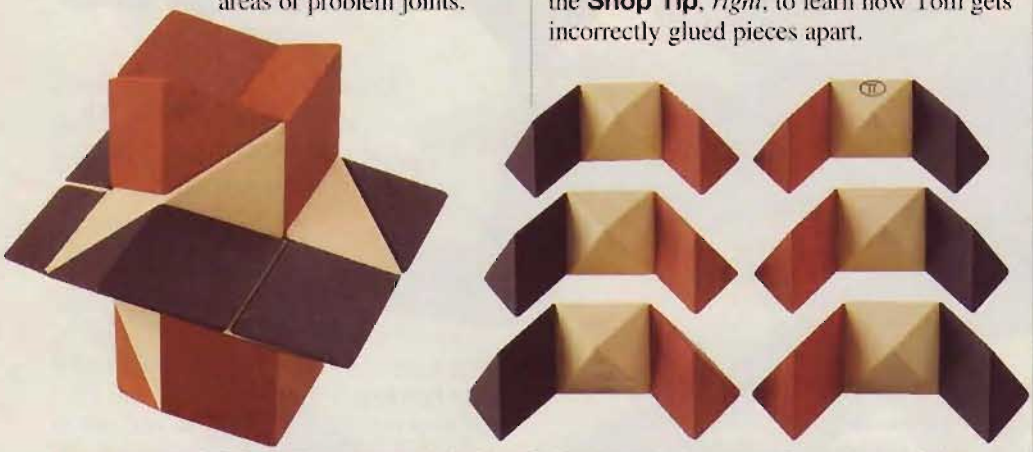
No matter how carefully the pieces are cut, a puzzle won't work properly unless its parts are glued together correctly. Tom joins most pieces using yellow woodworker's glue, but on occasion he uses two-part epoxy or polyurethane for hidden areas or problem joints.

Tom uses conventional clamps on some puzzles, but others require more creative methods. Often he simply holds the pieces until the glue gets tacky. At other times, he glues pieces together, then glues them to a piece of ¼" tempered glass. The flat surface holds the pieces in the right orientation and allows the assembly to be broken free. Read the **Shop Tip**, *right*, to learn how Tom gets incorrectly glued pieces apart.

Tom finishes his puzzles with a coat or two of tung oil. It offers protection without building up on the surface, which could prevent the puzzles from fitting together. Then he rubs on furniture paste wax to add a lustrous sheen.

While creating puzzles requires big demands for accuracy, this type of woodworking requires only a small work space. Tom's shop measures just 10×15'.

To see more of Tom's work, or to learn about the world of puzzlemaking, visit www.johnrausch.com/puzzleworld.



A puzzle called "Triumph" consists of six identically shaped pieces, each made up of three woods: ebony, pink ivory, and holly. Tom cuts the complex shapes on his tablesaw using just one shop-built jig to hold the workpieces at the proper angles.

SHOP TIP

A microwave glue redo

Even though Tom Lensch takes great care gluing up his puzzle pieces, occasionally he'll get them assembled incorrectly. Thankfully he doesn't have to trash his hard work and start over. He just "cooks" the small assembly in the microwave oven for 15 to 20 seconds. This softens the glue enough to allow the joint to be pulled apart.

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Recently, Ridgid introduced a new line of portable power tools targeted to professional users, and backed by a 3-year warranty. If the R2600 5" random-orbit sander is any indication, these tools appear to have hit the bull's eye.

The R2600's 3-amp, variable-speed, permanent-magnet motor is unusual for a portable power tool. Instead of coils of wire that can overheat and burn out, the motor uses powerful magnets. That makes this sander virtually unstoppable. With most random-orbit sanders I've used, bearing down while sanding usually causes the pad to stop turning. No matter how much weight I put on the R2600, the pad kept sanding along.

Speaking of the pad, the R2600 comes with a hook-and-loop pad installed. However, if you prefer adhesive-backed paper—even if only occasionally—Ridgid also includes an extra pad that accepts PSA sanding discs.

The soft grip covering the top of the sander proved its worth in dampening vibration. I sanded continuously for 30 minutes and my hand never got that tingly feeling I get with other sanders.

Ridgid has elevated the lowly power cord, as well. The unique plug has a light that tells you the outlet is "hot," and a sander-shaped icon shows you what tool is at the other end of the cord—handy when you have several tools plugged into a power strip or gang box. A hook-and-loop wrap attached to the 12'-long cord helps when it's time to stow the R2600 away for the day.

I do have one gripe about the sander: The cloth dust bag allows a lot of dust back into the air. However, the dust port fits both 2½" and 1¼" vacuum hoses, and connected to a vac, little dust escaped while sanding.

—Tested by Dean Fiene

Ridgid R2600 random-orbit sander

Performance	★★★★☆
Price	$80

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Come for the price, stay for the performance

When Ryobi's multi-base router kit landed on my benchtop, I didn't expect too much. I mean, really: For $180 you get the motor, plunge-, fixed-, and D-handle bases, a durable carrying bag, guide bushings and an edge guide. How good could it be?

The heart of the RE1803BK kit is its variable-speed, soft-start motor that fits in any of the three bases. Ryobi lists it as a 2-hp motor, but at 9.5 amps, it's on the low end of that range. Still, I made full-depth cuts in red oak using a ½" finger-joint bit, and the motor barely complained.

Setting the cutting depth with the fixed and D-handle bases requires twisting a ring that surrounds the base, which gradually raises and lowers the motor (and the bit) in the base. It's not nearly as fast or easy as other router kits where you simply thread the motor up or down, but it works. Once set to the right height, a lever locks the base in place.

I did notice that locking the lever caused the base to shift .028" off-center. For bearing guided bits, that's no problem, but when using the included guide bushings, Ryobi officials say you should re-center the subbase to the collet after locking the base to ensure accurate cuts. (The shift only occurs with the fixed and D-handle bases; the plunge base tightens with a threaded knob instead of the lever.)

Egg-shaped handles on the plunge base make it comfortable to hold, but I found the plunge springs pretty stiff. And the depth-setting system lacks a turret stop for routing in progressively deeper steps.

To change from base to base you must hold in the spring-loaded collet-locking pin while removing the base, which can be tricky. Using a precision ground steel rod, I measured just a hair more than .001" of runout (wobble) in the RE1803BK's ½" collet, which—based on our tool-testing records—is awfully good. Ryobi sends a ¼" adapter sleeve to use with smaller-shanked bits.

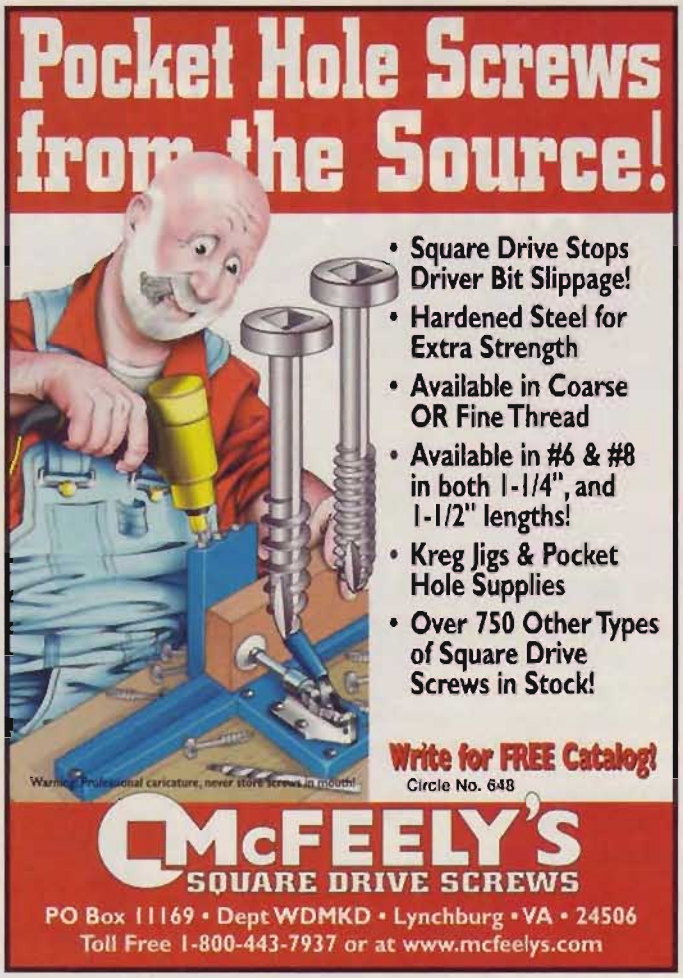
—Tested by Paul McClannahan

Ryobi RE1803BK multi-base router kit

Performance	★★★☆☆
Price	$180

Ryobi Technologies
800/525-2579, www.ryobitools.com

Continued on page 112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Bunjipeg hangs hard-to-hold hand tools

Sometime after the first caveman fashioned a crude hand tool from stone, he began looking for a way to hang it on the wall, so it wouldn't clutter up his bench. That's when somebody came up with perforated hardboard and peg hooks. And they were good, but they couldn't hold everything. Fast-forward to the 21st century, when another genius came up with Bunjipegs.

The Bunjipeg system consists of elastic cord and forked pegs that pin the cord into the holes in your perforated hardboard panel. Thus fastened, you simply slip hard-to-hold tools in behind the cord, and it holds them snugly in place. (The manufacturer says 10' of cord holds 25–50 tools, and should remain stretchy for about 5 years.)

I was amazed at how well Bunjipegs do their job. Tools such as chisels, steel rules, block planes, Forstner bits, and pliers of every size fit behind the cord and stay put. Occasionally, I had to readjust the length of cord between two pins to accommodate larger tools, such as the block planes or safety glasses.

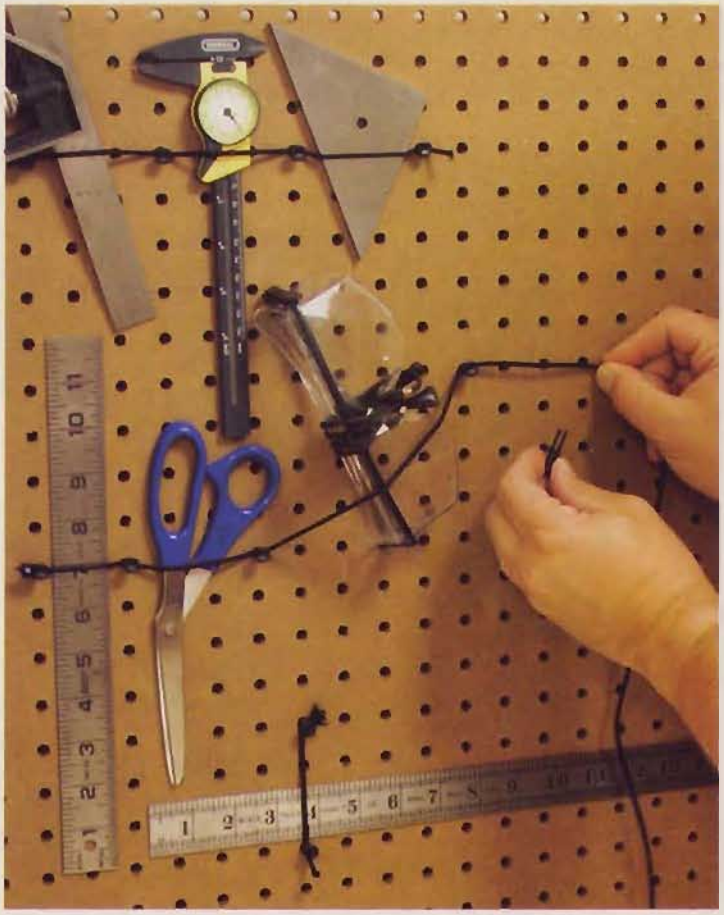
Bunjipeg held virtually every tool I threw at it, including a 15-lb. sledge hammer, but traditional peg hooks work better for some tools (such as the sledge). For example, it's faster and more secure to hang the 12" steel rule, shown *below*, from a hook. However, the 24" rule below it had no hole, and two short pieces of Bunjipeg, stretched vertically, held it fast.

—Tested by John Cebuhar

Bunjipegs

Performance	★★★★★
Price	$9, 24 pegs and 10' of cord; $10, 40 pegs and 18' of cord

Bunjipegs
919/571-1283, www.bunjipeg.com



Variable-speed grinder at a ground-level price

A basic high-speed bench grinder works great for heavy grinding and buffing. But woodworkers who sharpen their own chisels and plane irons prefer a slow-speed grinder that won't overheat and destroy the temper of their tools. So, do you need two grinders? Not if you have a Craftsman 6" Variable-speed Grinding Center.

Besides a speed range of 2,000–3,450 rpm, this compact grinder offers some nifty features, such as water cooling trays, large acrylic eye shields, and a goose-necked work light that can be operated even with the grinder off. And, a V-grooved plate holds twist-drill bits at the proper angle for sharpening.

The 6" Variable-speed Grinding Center's tilting tool rests mate to their mounting brackets with radial matching teeth, like two stacked poker chips. Although this arrangement locks the rest solidly, it also limits you to 15° increments.

Still, I was very satisfied with the performance of the 6" Grinding Center, putting sharp edges on all of my turning tools, bench chisels, and drill bits. Its $80 price tag includes a 60-grit aluminum-oxide wheel, a wire wheel, and a serrated wheel dresser that stores on the grinder.

—Tested by Jeff Hall

Craftsman 6" Variable-speed Grinding Center (21152)

Performance	★★★★☆
Price	$80

Visit your Sears store
www.sears.com/craftsman

Continued on page 114

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1 Ogee With Fillet
1 Plunging Roundover W/ Bead
1 Double Roman Ogee W/ Cove
1 Plunging Roundover
1 Stepped Cove
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Canada, North America

Circle No. 1979

This unique drum sander does things the others can't

Over the past several years, wide-bodied drum sanders have become popular in home woodworking shops, as we continue our quest to take the drudgery out of sanding. Like a thickness planer, though, those tools can only make two opposite faces of a workpiece parallel. The Sand-Flee PS35000 isn't limited in that way.

In fact, the Sand-Flee works more like a jointer. After setting the stainless-steel tabletop just a hair lower than the top of the drum during the initial setup, you pass the workpiece over the drum by hand, giving you control over the feed rate and pressure. In my tests, I found it impossible to bog down the tool's ⅓-hp motor, no matter how hard I pushed.

The lack of a self-feeding mechanism is a big plus in many ways. For example, I easily sanded some very small scrollsawn workpieces that would get lost between the pressure roller and drum of a traditional horizontal drum sander. You also can sand extra-thick or tall workpieces on the Sand-Flee because you're not limited by the distance between the feed belt and drum. (Most drum sanders max out at about 3" of thickness.) It's especially handy for sanding box joints and dovetails smooth after assembly.

Although workpieces shorter than about 2' long sand like a dream, keeping consistent pressure on longer workpieces is more problematic, and I couldn't get as smooth a surface as I get sanding those same pieces on my self-feeding drum sander.

Hook-and-loop abrasives install quickly on the Sand-Flee's 18"-long polycarbonate drum, so you can start and stop an abrasive strip anywhere along the drum. I loaded three grits of progressively finer paper on different parts of the drum and quickly sanded a narrow workpiece through three grits without changing paper. Much of the dust created drops harmlessly below the tabletop, and a 2½" dust port hooks nicely to a shop vacuum to make it even cleaner.

The manufacturer touts the Sand-Flee as "portable," and it is, to some degree. You can stand it on edge for storage so it doesn't always take up the 21×35" footprint created by the wooden mounting base, which, by the way, you must provide.

—Tested by Marlen Kemmet

Sand-Flee PS35000

Performance	★★★★☆
Price	$450

Advanced Machinery
800/727-6553, www.advmachinery.com

One-handed clamp becomes light-duty vise

Since Quick-Grip launched the first one-handed bar clamp, other manufacturers have followed suit to get their own piece of that lucrative market. Wilton's Multi-Grip Holding System brings a couple of new features to the table—pretty much any table.

More than a bar clamp, the Multi-Grip Holding System consists of a one-handed clamp and a portable base that easily mounts to any tabletop between ¼" and 2½" thick. The bar of the clamp, then, locks into the base's head to make an instant vise. While power carving with my high-speed rotary tool, I like that the head rotates 360° and locks in any of 16 positions.

So, have Wilton engineers done anything to improve the clamp itself? You bet. A fixed jaw that flips to turn the clamp into a spreader isn't anything new, but Multi-Grip's fixed jaw locks anywhere along the full length of the bar. That means you can reposition that jaw and the fixed jaw to better balance the clamp.

The in-line design of the Multi-Grip clamp's trigger (the part you squeeze to advance the jaw), along with a "foot" on each jaw allow the clamp to stand on its own. This trigger configuration works pretty well with the clamp horizontal, but with the bar vertical (when clamping a tool base to a bench, for example), it's more difficult to manage.

One other nice touch: A grooved pair of jaw pads replaces the Mutli-Grip's normal smooth faces for holding a round workpiece. They held fast while I hand-sawed a dowel, and also worked well on the odd-shaped base of my carving.

—Tested by Jeff Hall

Multi-Grip Holding System

Performance	★★★★☆
Price	$30

Wilton Tools
888/804-7129, www.wiltonmultigrip.com

Continued on page 116

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Workmate on wheels stays put when working

Since its introduction nearly 30 years ago, the name "Workmate" has become synonymous with "portable clamping workstation" (like "Jell-O" and "gelatin"). Black & Decker's WM375—the latest incarnation of the venerable shop accessory—adds wheels to make it more mobile, a big plus if you're not as young, or strong, as you used to be.

Another bonus with the WM375 is that it folds flat with the pull of a single lever beneath the tabletop. That sure beats the release latches on the old Workmates, and folding up the four short legs at the bottom.

The WM375's heavy-gauge steel frame supports up to 350 lbs of projects or benchtop power tools without tipping, sagging, or wiggling. Even though that's 100–200 lbs less than other Workmate models, it's plenty for any task in my woodworking shop.

My only disappointment: The wheels work only with the WM375 in its folded-for-storage position. I hoped it might work like a mobile base, where the workstation and tool could be easily moved around the shop. Still, its price and portability make it a good value.

—Tested by Paul McClannahan

Workmate WM375

Performance	★★★☆☆
Price	$60

Black & Decker
800/544-6986, www.blackanddecker.com

what's ahead

Just some of the articles on deck for the May issue (available at newsstands **March 23**)

Projects for your home, shop, and outdoor spaces

FEATURED PROJECT

Easy glider

Float off into the summer sunset on this comfy addition to the Adirondack-style settee, planter, chair, and footrest featured in previous issues.

Torpedo level

Good-looking enough to be displayed, but built to survive your toolbox, this little beauty will prove indispensable around your home and shop.

3-piece kid's set

"Fast to make" and "fun to give" will describe your experience with this trio.

Traditional sideboard

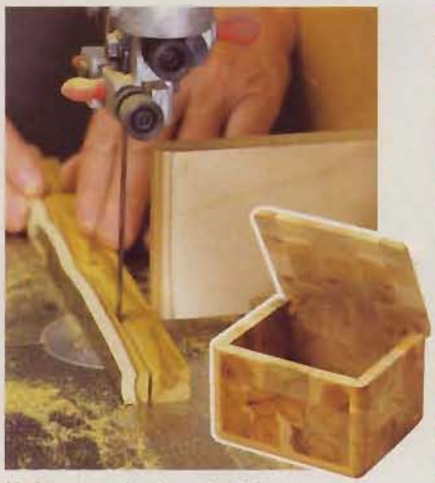
Build this handsome serving piece as a stand-alone, or to match the oak dining table featured in issue 152 and the dining chair detailed on *page 80*.

Tools, tips & more

TOOL TESTS

Tablesaw fences and splitters

Does your saw deliver safe and precise ripcuts? If not, it may need an after-market rip fence or splitter. Check out our ratings of today's top products.



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